FOREST SECTOR MODELLING IN NEWFOUNDLAND

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Doctor of Philosophy

University of Edinburgh

1986

DECLARATION

This thesis has been compiled from my own original research. The work of, and assistance by others is acknowledged. All work for this thesis was conducted in the Department of Forestry and Natural Resources, University of Edinburgh.

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ACKNOWLEDGEMENTS

During the course of this research, many individuals provided valuable assistance, advice and encouragement without which, the thesis could not have been completed. First and foremost, I must acknowledge the financial support of my employer, the Canadian Forestry Service - Government of Canada, given through a 31 month paid Education Leave. The provision of full salary and payment of all direct educational costs has allowed me to concentrate on my studies in an atmosphere free of financial worries. Two individuals from the Newfoundland Forestry Centre, St. John's, are largely responsible for this opportunity to further my education; Dr. W.J. Carroll - former Regional Director(retired), and Dr. J.A. Munro - current Regional Director. Both of these individuals encouraged me to pursue a PhD., provided strong support for my case at senior management levels in Ottawa, and guided my application through the long and often frustrating process to final approval. I am also indebted to Dr. Munro for allocating over the past 2 years, sufficient funds to allow a moderate level of work-related travel in several European countries.

There are many others who also must be acknowledged. From the Newfoundland Forestry Centre, the efforts of Miss Dana Hayden, Economist, to locate and forward data required in the thesis, have been of considerable help.

From the Newfoundland Statistics Agency - Government of Newfoundland and Labrador, George Courage, Director, and Roseann Norris, Statistician, sent a large volume of data in response to my written request.

I must also acknowledge the assistance provided by two individuals from the Economics Branch, Canadian Forestry Service, Ottawa. Doug Ketcheson, Director, and Suzanne Gailloux, Head-Statistical Support Services, were unfailing in their positive replies to numerous requests for a wide range of information needs.

In Scotland, I must thank several individuals from the University of Edinburgh for their advice and assistance. Mr. Ian Stewart from the Department of Economics very kindly agreed to review a draft of the thesis and provided many valuable comments. Mr. Stewart, along with Dr. Howard Wagstaff, Department of Agriculture, provided important input to one key chapter through open discussion in the early stages of the thesis. Also, the contribution of Mrs.

Margaret Jackson - Department of Forestry and Natural Resources, for typing the written drafts into the computer within my tight time schedule should be recognized.

Finally, I must acknowledge the critical role played by my supervisor and colleague, Dr. W.E.S. Mutch, Head of the Department of Forestry and Natural Resources. Initially, my selection of Edinburgh University was due in large part to Dr. Mutch's continuing positive and encouraging replies to my correspondence, beginning in 1983. With my thesis, Dr. Mutch has been of considerable assistance, sharpening my ideas where necessary, providing valuable comments and suggestions for each chapter, and acting as a sounding-board for new approaches. This thesis and my general approach to research, have been greatly improved from his input. Also, Dr. Mutch often exceeded his required supervisory responsibilities in such matters as assisting my family to secure accommodation and, providing me every opportunity to attend professional meetings of foresters and participate in study tours. For this I am grateful.

In Britain, I must also acknowledge the financial support provided by an Overseas Research Student Award through the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom.

There is one final person who deserves a special acknowledgement and to whom this thesis is dedicated; my wife Colleen. First, her efforts at the often thankless task of editing numerous drafts on the computer, to my high standards, must be recognized. Most important however, is the appreciation of her giving up a teaching career in Newfoundland, coming to Scotland, and beginning a new career as a full-time mother. Colleen's constant encouragement and support throughout the past 2 years have played an important part in the completion of this study.

While the contributions of all the aforementioned individuals are acknowledged, I alone am responsible for any errors or omissions in this thesis.

ABSTRACT

The use of stumpage price as a measure of resource value in public policy development and analysis is seen as a major constraint to more effective forest planning in Canada. Stumpage prices for commercial forests are normally established by the provincial governments in the absence of competitive timber markets. Current stumpage prices reflect historic trends in government policy concerning economic development and tenure in the forestry sector. Another contributing factor is past forest management practices based on resource mining. One result is timber prices which are poor indicators of the resource's value to both government and society as a whole.

Three models are derived to yield improved measures of forest resource value for internal government application to planning and policy. The first model equates government forest sector expenditures with the level of benefits received. The second model obtains a net government income value based on the difference between forest sector public revenues and government forest sector expenditures. The third model estimates a partial measure of net social value from forest sector value added, less government forest sector expenditures. All three models provide resource values expressed on a unit volume and unit area basis. Using four criteria(theoretical soundness, practicality, statistical characteristics, relevence to policy applications), the third model is selected as the best approach.

With Newfoundland as a case study, the third model is used to address four key policy issues of forest protection, land-use conflicts, silvicultural investments and public funding in forestry. The model is shown to be a potentially useful tool for public forest sector planning and policy, with applications in a wider range of natural resources in many countries.

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ABBREVIATIONS AND SYMBOLS

AAC	Annual Allowable Cut
A.N.D. Co.	Anglo-Newfoundland Development Company
B.C.	British Columbia
CFS	Canadian Forestry Service
DFRL	Department of Forest Resources and Lands
ENFOR	Energy From The Forest
FAO	Food And Agriculture Organization
FERIC	Forest Engineering Research Institute of Canada
FESP	Forest Economic Stimulation Program
FORINTEK	Forest Industry Technology (Research Institute)
FSA	Forestry Subsidiary Agreement
GDP	Gross Domestic Product
GNE	Gross National Expenditure
ha. or Ha.	Hectare
Isle.	Island
km. or Km.	Kilometer
$km.^2$ or $Km.^2$	Square Kilometer
m^3	Cubic Metre
m^3/ha.	Cubic Metre Per Hectare
MFBM	One Thousand Foot Board Measure
MK	Finnish Mark
Nfld.	Newfoundland
NFC	Newfoundland Forestry Centre
N.W.T.	North West Territories
SOC	Social Opportunity Cost
STP	Social Time Preference
$	Dollars Canadian(unless otherwise stated)
%	Percent
$\bar{x}$	Mean or Average
<	Less Than
>	Greater Than
-	Values Insignificant or Too Small To Be Included

1.0 INTRODUCTION

Estimating the value of Canada's forest resources has long been a topic of considerable debate among forest economists throughout the country. This debate may take several forms; for example, what is the value of all forest resources in Canada? Or what is the value of forests used specifically for commercial timber production? Another point raised is the fundamental one of the basis for valuation of the forest resource; should a measure of value reflect its worth to industry, government, or society as a whole? Much of the debate has centred on commercial forest resources and their value to both government and the broader concept of society. This fact is not surprising given the vast scale of Canada's forest resources and the importance of the country's large forest industry to the national economy.

At present, the bulk of the forest resources are held under Crown ownership by the ten provincial governments. These governments therefore have responsibility for resource policies within provincial boundaries, including resource pricing. Throughout most of Canada, cutting rights to commercial forest resources are rarely sold to private interests through some system of competitive bidding. Instead, cutting rights are usually allocated through a mixture of long and short-term tenures with timber prices either negotiated, or arbitrarily set by the Crown. These timber prices (stumpage prices in Canadian terminology) are often felt to be lower than might be the case under a more competitive market for timber where a market price represents an equilibrium in exchange value between buyers and sellers. One consequence is that Crown resource owners may be forfeiting a portion of the resource's full economic rent to industry. Of equal importance is the potential impact from applying these stumpage prices in policy development and analysis. If stumpage prices do represent an inadequate measure of resource value, consequent government policy decisions may be made which are not in the best interests of all Canadians. Examples include inefficient land-use decisions between forestry and competing interests, and less than optimal public investments in forest capital.

Problems arising from inadequate measures of resource values in forestry, crop up repeatedly in the experience of forest economists in Canada.

There have been many instances where an economic study or analysis of forest policy has been hampered by the use of stumpage prices to represent the value of commercial forest resources. While the analyses are being carried out, the nagging doubt in one's mind is that stumpage prices simply do not provide an adequate measure of forest resource value, either to government or society as a whole. In Newfoundland, this situation is exacerbated by the fact that two of the three newsprint mills in the province do not pay any stumpage for pulpwood under the terms of timber agreements signed with the provincial government several decades ago. Given these circumstances, one is easily frustrated when conducting economic studies or policy analysis relating to commercial timber allocated to these companies. The need for an improved measure of forest resource value is all too clear.

Occasionally, one hears the suggestion that to resolve this problem all that need be done is for governments to change their stumpage pricing methods to a system of competitive bidding. In theory, such a move would probably improve the economic basis of timber values in Canada. However, experience has shown that the implementation of such a scheme would be difficult in practice. Current stumpage prices are a direct result of past government policies which were designed to encourage economic development of remote interior and northern regions. In return for low stumpage rates and an assured wood supply, the forest industry provided the province with the economic benefits of increased employment, income and tax revenues. This approach to timber pricing appears to have continued to the present time in many provinces. Provincial governments value these economic benefits, and politicians tend not to place increased timber prices as a policy priority. Instead, the provision of a stable, low-cost timber supply to industry is a prime objective. One might argue that the economic benefits from forest industry activity would continue even if timber prices were increased through competitive bidding. However, this argument fails to consider the political aspects of resource pricing. In many regions, forestry is the only form of industrial activity available for individuals to earn income. Thus, the industry is in a position to apply considerable political pressure to resist government moves to introduce competitive timber markets. Also, in some regions there may not be sufficient numbers of mills (or even only one mill) to develop a more competitive wood market. As well, given that much of the industry may be harvesting near the extensive margin of production at present, the ability to pay higher stumpage prices is constrained. In the next rotation, when managed stands closer to mills are harvested, there may be more scope to pay higher stumpage. However, at the present time, it is difficult to conceive of all provincial governments drastically changing their current stumpage pricing systems.

As an alternative, the suggestion has been made that a shadow price should be estimated for commercial timber, in other words deriving a price that would arise if competitive markets existed. In Newfoundland at least, this approach is greatly constrained by a lack of data on the industry's harvesting and processing costs. By deducting these costs from product values (lumber, pulp etc.) and allowing a margin for normal profit, a residual value results which represents the full economic rent of the timber resource. This value can then be assumed to represent a fair price which the provincial government could charge industry for commercial timber. However, given the lack of published information on industrial cost structures, these shadow prices are often nothing more than educated guesses.

In this whole discussion of timber prices and resource valuation a question often raised is whether stumpage prices of any kind are an appropriate criterion for valuing what is largely a publicly owned resource. One approach is to ignore the question of timber pricing and to seek other means of valuing forest resources that are used for commercial production. This approach recognizes that in Canada, stumpage is simply a revenue flowing to provincial governments from the industrial harvesting and processing of commercial timber. A need does exist to develop an improved measure of resource value for use in internal government policy decisions. Such a value should not however be confused with, or substituted for, stumpage prices.

In recent years, there has been a growing public awareness of forestry in Canada and the importance of the forest industry in the national economy. Through various media forms, the benefits accruing to Canadians from the forest resource have been emphasized, especially the economic benefits from commercial timber production, such as employment, income and export earnings. In addition, there has been extensive publicity of the large scale of tax revenues flowing from industry to both provincial and the federal governments. These statements appear to imply that the forestry sector, comprising the resource and associated industries, has a value to the individual provinces and to the country as a whole, far greater than is reflected by simple timber stumpage prices. My personal views tend to coincide with this general public perception of forestry and forest resource values. These forestry benefits are relatively well-quantified at present, but the problem, as I appreciate it, is to link these benefits directly to the forest resource. Given that the forest industry generates a specific level of economic benefits each year, how can one derive a value for the forest resource itself? The intuitive rationale here is that the commercial timber resource is the primary input in the chain of harvesting and processing wood products. Therefore, the central objective of this thesis is to evaluate alternative methods of valuing the forest resource, based on various measures of economic benefit generated by the forestry sector. These values must be derived not only for the entire commercial forest resource of any province, but on a volume and area unit basis. Experience has shown that unit resource values are more applicable to policy and economic analysis than aggregate values. An associated objective is to develop these methods of valuing the resource from the perspective of government and society as a whole.

A second major goal of this thesis is to develop valuation methods with the aim of selecting one approach best suited for applied use in policy analysis. Thus, any method selected must be practical and fairly simple for the non-economist to use and understand. Throughout my career, I have observed many examples where complex analytical methods and models have failed to be used by the forester in the field, senior bureaucrats or even politicians. The lesson is simple; no matter how theoretically perfect a method may be, if people cannot understand it, the approach will not be used. Methods which are rejected on such grounds are often overly concerned with detail and require a level of refinement or data which is unrealistic. Therefore, any model developed in this thesis must recognize the practical constraints of data availability, ease of understanding and realistic application to current problems in forest policy. At the same time however, a certain level of economic rationale must be maintained. Thus, a balance is required between practicality and economic theory.

Because of my familiarity with, and experience in Newfoundland, I will use that province as a case study both for the data themselves and for policy applications. However, any valuation methods developed in the thesis should in principle be of practical use in other provinces. On a wider scope, the methods should also have relevant applications outside Canada and for natural resources other than forests.

The structure of the thesis is as follows. Chapter 2 provides a general background on Canada and a more detailed description of Newfoundland. First, the physical, historical, social and economic characteristics are discussed. Then, a description of the forestry sector in both Newfoundland and Canada as a whole is presented. Chapter 3 examines the concept of value and in more detail, the concept of social value. The chapter also examines the nature of forest resource valuation in Canada and Newfoundland. The problem of inadequate forest resource valuation is a central theme. Chapters 4 and 5 develop alternative approaches to valuing forest resources used for commercial timber production. Three value models are derived, from the perspective of both government and society. Using data from Newfoundland, resource values are estimated for each model. Chapter 6 provides a discussion of the results from the previous chapter and selects one model for use in policy analysis. The criteria used in selection are each model's theoretical basis, practical characteristics such as data availability and ease of understanding, statistical parameters, and applications to forest policy. Chapter 7 uses the one model selected, in four policy applications in Newfoundland. These are forest protection, land-use conflicts, silviculture investments, and government funding decisions. Finally, chapter 8 provides a summary of the thesis and recommendations for further research in this field.

2.0 NEWFOUNDLAND AND THE ROLE OF FORESTRY IN THE PROVINCIAL ECONOMY

2.1 THE PROVINCIAL LAND BASE AND CLIMATE

Newfoundland is comprised of both an insular area and, Labrador on the mainland of Canada (Figures 1 and 2). The total area of the province is approximately 405,000 square kilometers (km^2), or 4.1 percent of the total area of Canada (Table 1).

TABLE 1

Area classification, Newfoundland and Canada[a]

Area Class	Island Region	Labrador Region	Total For Nfld.	Canadian Total	Nfld. vs. Canada
	1,000 km^2				(%)
Forest Land[b]	63	79	142	3425	4.1
Agricultural Land	-	-	-	659	-
Wildland[c]	37	192	229	5083	4.5
Total Land	100	271	371	9167	4.0
Total Water	11	23	34	755	4.5
Total Area	111	294	405	9922	4.1

[a]Source: (Anon., 1984a; Milne and Munro, 1981).
[b]Includes productive and non-productive forest.
[c]Includes land not inventoried, urban land, bogs and barrens.

For each area classification, Newfoundland consistently represents between 4.0 and 4.5 percent of the Canadian total. Within Newfoundland, the Labrador region represents nearly 75 percent of the provincial land base. Labrador rests entirely on the physiographic region known as the Canadian shield and is characterised by rock, frozen organic and sporadically frozen

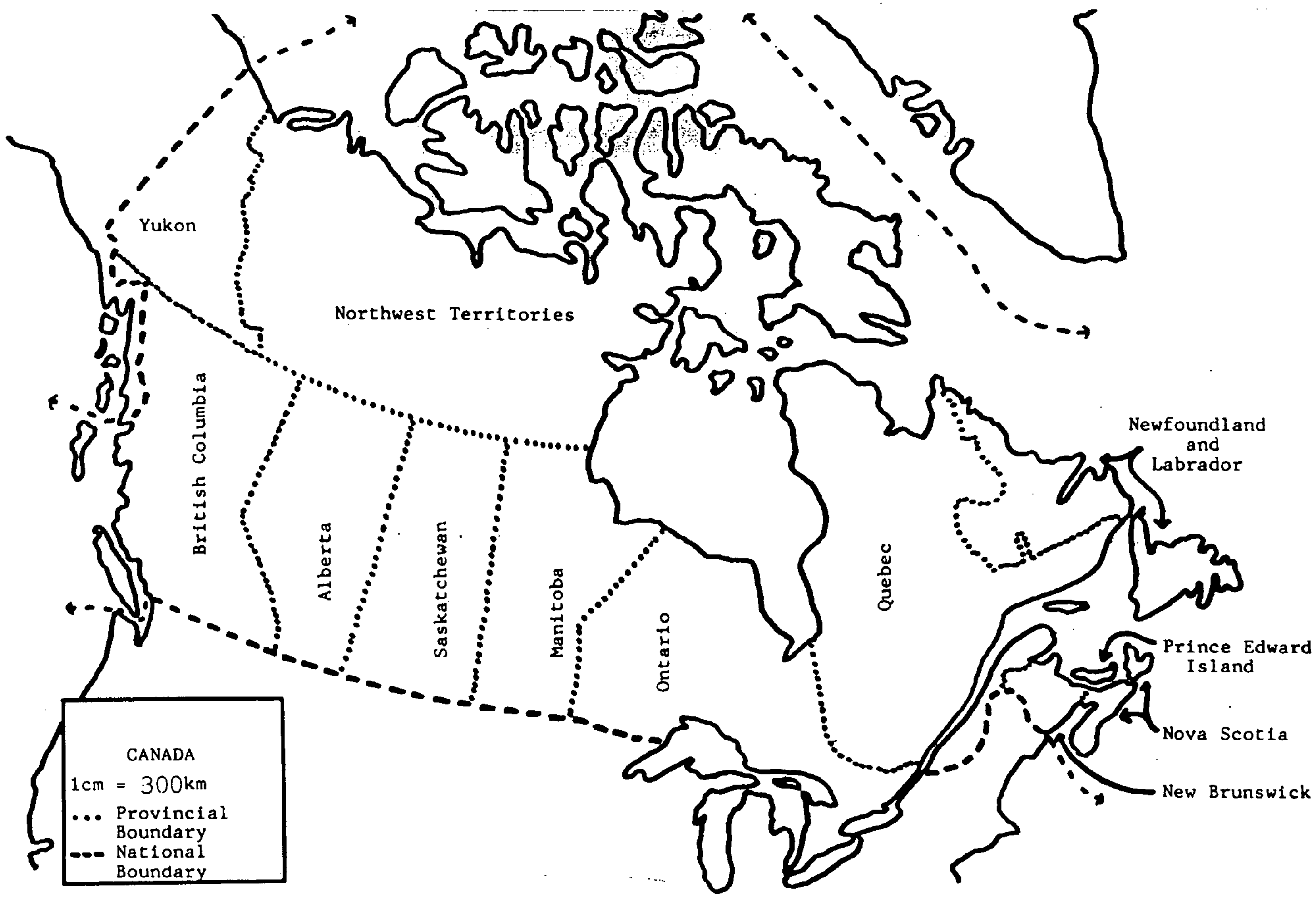
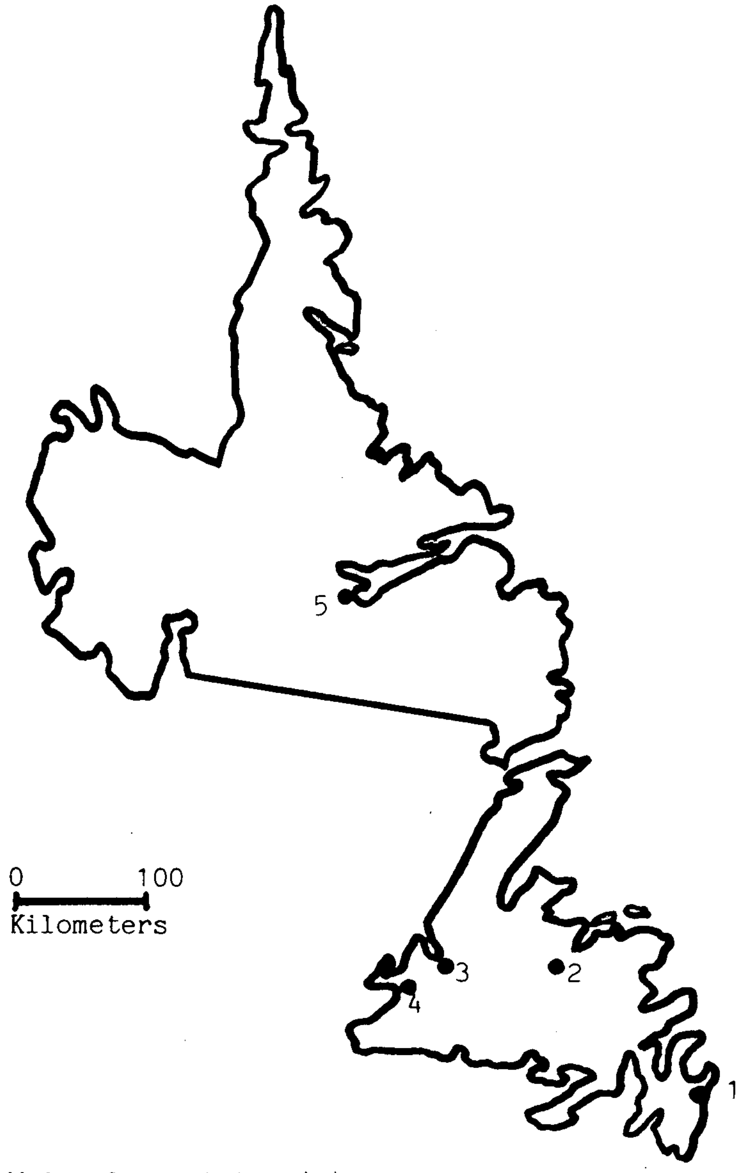


Figure 1. Political map, Canada



Major Communities (•)

1. St. John's
2. Grand Falls
3. Corner Brook
4. Stephenville
5. Goose Bay

Figure 2. General map, Newfoundland and Labrador

brunisolic and gleysolic soil types (Rowe, 1972). The topography of Labrador ranges from sea level to 600 metres, however there are mountain ranges in the north with elevations exceeding 1200 metres.

The Island of Newfoundland is associated with the Appalachian physiographic region of Canada (Rowe, 1972). This region is characterised by rock, organic, podsolic, luvisolic and brunisolic soil types. The topography of the island ranges from sea level to 600 metres. The higher elevations are found in the Long Range mountains extending up the west coast and the Great Northern Peninsula.

The climate of Newfoundland can be described as harsh with a rather short growing season. The major influencing factor is the cold, southward-flowing Labrador current. The interaction of the cold water with warm air masses and the warm Gulf ocean current south of the Island creates a cool, windy climate (Munro, 1978). The mean annual length of growing season ranges from 40 days in northern Labrador, to 160 days in some areas of the Island (Rowe, 1972). Much of the Island and southern coastal areas of Labrador are subject to high levels of annual precipitation.

2.2 THE FOREST RESOURCE BASE OF NEWFOUNDLAND

The productive forest resource in Newfoundland falls completely within the Boreal forest region (Rowe, 1972). Productive forests refer to lands capable of yielding a timber stand of 35 cubic metres per hectare (m^3/ha) at maturity. On the Island, these forests are concentrated in the central and western areas (Figure 3). In addition, there are aggregations of productive forest on the Avalon and Great Northern peninsulas. The dominant softwood species are balsam fir (*Abies balsamea* (L.) Mill.) and black spruce (*Picea mariana* (Mill.) B.S.P.). In eastern and east central areas, black spruce is the most common softwood. In western, west central and northern areas, balsam fir predominates. White birch (*Betula papyrifera* Marsh, and *Betula cordifolia* (Reg.) Fern) is the most common hardwood, found primarily in central and western regions of the Island. Overall, softwood stands (>75 percent softwood) comprise 74 percent of the Island's productive forest area (Hudak and Raske, 1981).

Figure 3. Forest resources, Island of Newfoundland

In Labrador, productive forests are located mainly in large river valleys in central and south-eastern areas (Figure 4). The dominant softwood species is black spruce while white birch is the most common hardwood. Overall, softwood stands make up 95 percent of Labrador's productive forest.

On a broader scale, the province's productive forest represents nearly four percent of the national total (Table 2). Approximately 45 percent of the province's productive forest area is located on the Island.

TABLE 2

Forest Classification, Newfoundland and Canada[a]

Forest Land Classification	Forest Area (,000 hectares) Newfoundland Island	Labrador	Total	Total for Canada
Productive	3,784	4,716	8,500	220,200
Non-Productive	2,516	3,184	5,700	122,300
Total Forest	6,300	7,900	14,200	342,500
Total Area - All lands plus water	11,100	29,400	40,500	992,200

[a]Source: (Anon., 1984a, Milne and Munro, 1981)

Productive forests in Newfoundland comprise 21 percent of the total provincial land and water area. On the Island this figure is 34 percent while for Labrador, productive forests form 16 percent of the total area. For Canada, productive forests comprise 22 percent of the total area.

The gross merchantable softwood volume on stocked productive forest land on the Island is an estimated 174 million m^3, using 1979 data (Anon., 1981b). At maturity, softwood stands on the Island attain heights of 9 to 15 metres and volumes of 70 to 175 m^3/ha (Hudak and Raske, 1981). On extremely productive sites, average stand volumes may reach 350 m^3/ha. For the Island, the annual allowable cut (AAC) for softwoods was estimated at approximately 3.0 million m^3 during the 1980 Royal Commission on forest

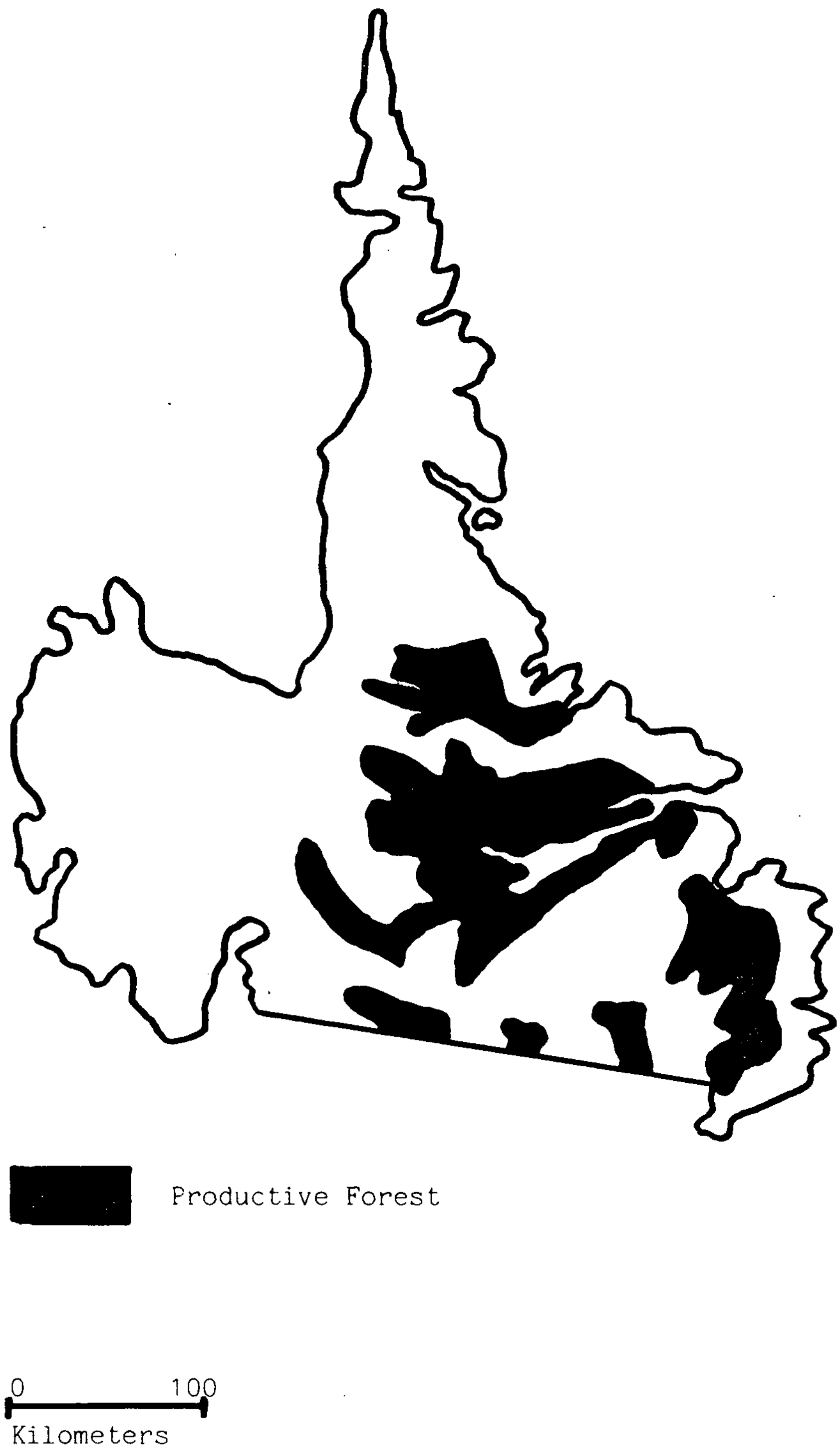


Figure 4. Forest resources, Labrador

protection and management (Poole *et al.*, 1981a). This AAC figure is in need of revision due to a range of factors which have influenced timber volumes since the early 1970's, the most important of which has been the recent spruce budworm (*Choristoneura fumiferana* (Clem.)) outbreak. From 1972 to 1980, approximately 40 million m^3 or 23 percent of the Island's gross merchantable softwood volume had been damaged (Pool *et al.*, 1981a). Nearly one half of the damaged stands were classified as dead (Figure 5). Since 1980, the outbreak has moderated, however the volume of stands in the dead and dying classes has increased. The 1980 AAC projections therefore require updating.

A second influencing factor is the impact of intensive management treatments conducted mainly since 1974. The effects of large planting and thinning programs on the softwood AAC could be substantial but as yet are unquantified.

A third factor to consider is withdrawals of productive forest land to alternate single uses. For the period 1960 to 1979, a total of 74,200 hectares of productive forests, containing 3,373,000 m^3 of timber were alienated to alternate uses such as roads, mines, parks, wildlife reserves and hydro-electric developments (Anon., 1981b). These alienations have continued since 1979 and will obviously influence current AAC estimates.

The extent to which these influencing factors balance out is unclear at present. In the absence of more recent and accurate data, the 3.0 million m^3 AAC figure for the Island will be used in the study.

In Labrador, the total gross merchantable softwood volume on stocked, productive forest land was an estimated 53,311,000 m^3 in 1979, restricted to accessible regions only. The AAC associated with this timber volume was approximately 900,000 m^3. The Labrador timber resource has been relatively isolated from the factors which have influenced the Island's softwood stocks. Therefore, the Labrador AAC has remained fairly static since 1979. Compared to all of Canada, Newfoundland comprises less than two percent of the total softwood growing stock and AAC. Nonetheless, forests are a major component of the provincial land base.

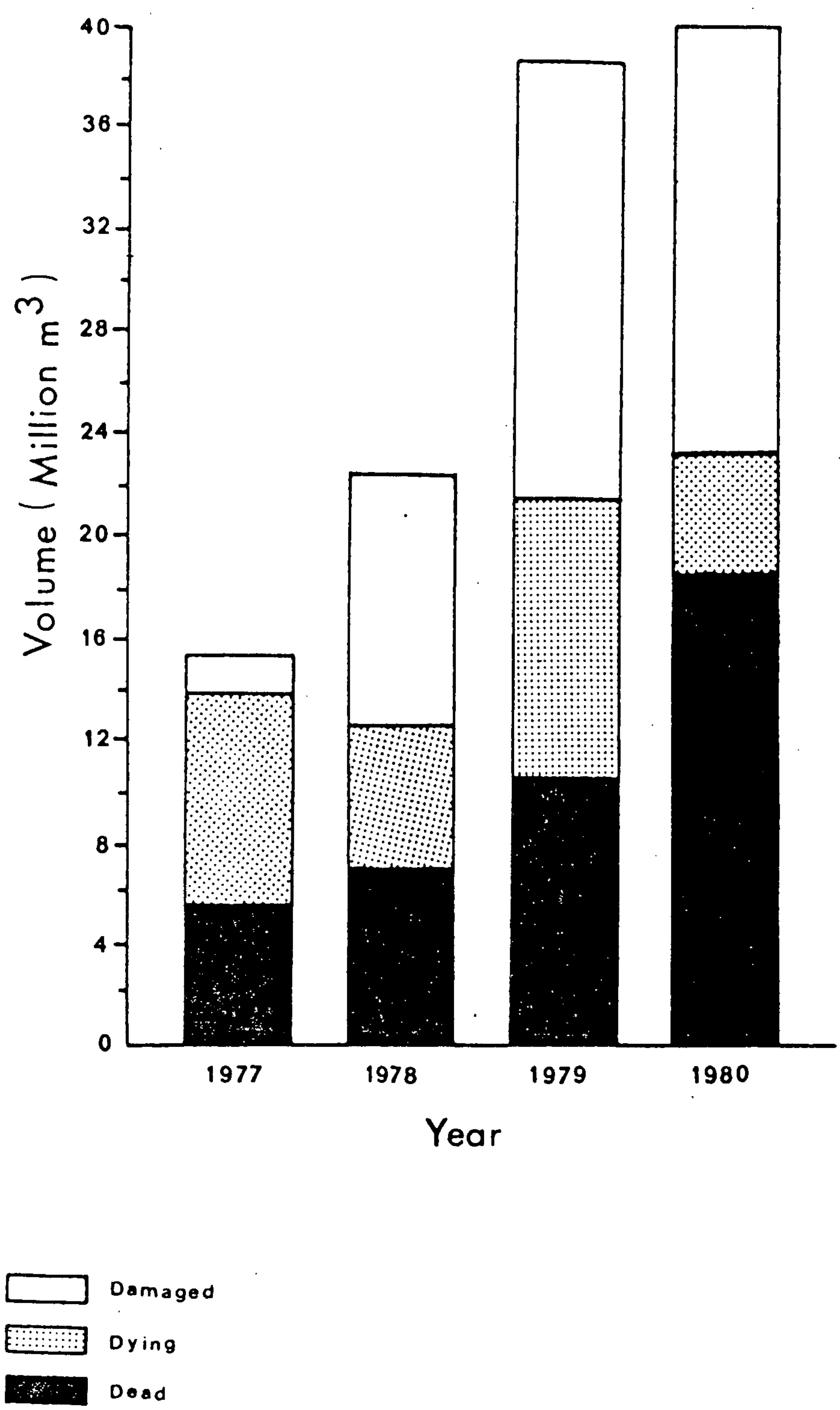


Figure 5. Spruce budworm damage in Newfoundland to 1980.

The current structure of forest land ownership was heavily influenced by tenure arrangements which developed at the turn of the century.[1] Presently, the pulp and paper industry occupies 56 percent of the Island's productive forest through a mix of tenures (Table 3).

TABLE 3

Productive forest land tenure, Island of Newfoundland 1981[a]

Forest Land Holder	Total Land Holdings (000 ha)	Productive Forest Land (000 ha)	% of Total Productive Forest (%)
Private Industry	4,559	2,124	56
Provincial Government	6,396	1,535	41
Federal-Municipal	194	125	3
Total	11,149	3,784	100

[a]Source: (Poole *et al.*, 1981b; Anon., 1981b; Milne, 1984a)

Although the industry holds rights to 4.6 million hectares of land on the Island, only 2.1 million hectares are productive forest. One should note that the designation of private tenure in Table 3 does not imply private ownership. An examination of industry tenured land reveals that only 8.5 percent is actually privately owned. The remaining 91.5 percent of private land tenures are owned by the provincial government as Crown land, but are either leased or licenced to industry (Table 4, Figure 6).

In Labrador, virtually all productive forest land is currently classified as unalienated Crown land. On these areas the provincial government maintains complete ownership.

[1]A more detailed description of tenure evolution is provided in chapter 3.

TABLE 4

Private industry forest land holdings, 1981,
Island of Newfoundland[a]

Pulp and Paper Company	Tenure Type and Area (000 ha) Freehold	Lease	Licence	Total
Bowater	607	nil	1,957	2,564
Abitibi Price	160	518	1,317	1,995
Total	767	518	3,274	4,559

[a]Source: (Poole *et al.*, 1981b)

2.3 THE PEOPLE AND ECONOMY OF NEWFOUNDLAND

2.3.1 Historical Background [2]

To better understand Newfoundland and its present economic structure, one must first look at the history of the province. The first Europeans to reach Newfoundland were Viking explorers who temporarily settled at L'Anse au Meadows on the Great Northern peninsula nearly 1000 years ago. A more permanent discovery was not until 1497 when John Cabot landed on the east coast of the Island. Although Cabot is officially credited with discovering Newfoundland, English fishermen were thought to have harvested cod from the Grand Banks prior to 1497. For the next 200 years, Newfoundland was primarily used as a supply base for the summer fishing fleets from England, France, Spain and Portugal.

[2]Much of the information presented in this section is derived from; (Economic Council of Canada, 1980).

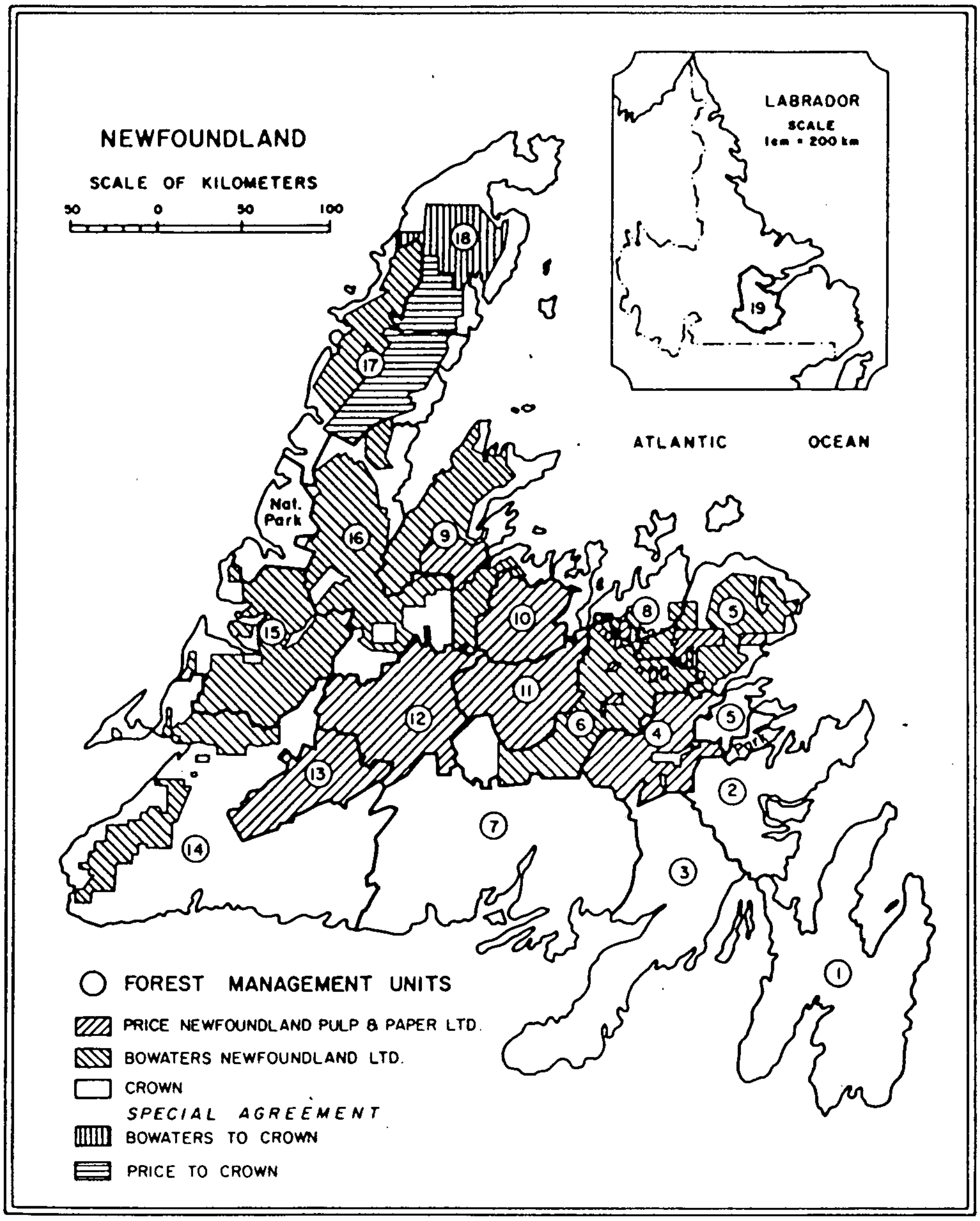


Figure 6. Forest land tenure, Newfoundland, 1981

Politically, England officially claimed Newfoundland as a colony in 1583. This claim was strengthened through the victories achieved in wars with France during the seventeenth and eighteenth centuries. Until the early 1800's, settlement on the Island was restricted to prevent a competing domestic fishery from developing. These restrictions were lifted in 1824 and over the next quarter century, a large influx of immigrants from southern Ireland and western England settled in Newfoundland. By the late 1800's, immigration declined greatly. Given the Island's isolation, a unique culture with strong Irish and English roots developed.

Until the twentieth century, the Island's economy was dominated by fishing. As a result, the bulk of the population was scattered along the 10,000 km coastline in more than 1,000 small communities, or outports. By the early 1900's, the economy began to diversify along with settlement of interior regions as forestry and mining developments occurred. In addition, the land area of Newfoundland increased by a factor of four when the Judicial Committee of the Privy Council of Great Britain awarded ownership of Labrador to the colony. This legal decision, in 1927, brought Newfoundland a wealth of natural resources.

The depression of the 1930's was felt severely in Newfoundland. Export markets for natural resource based commodities such as fish, dropped drastically causing rising unemployment and relief payments, and reduced public revenues. The depression severely strained the fiscal capability of the Newfoundland government.

These trends were reversed during the Second World War which brought a massive inflow of Allied military personnel and capital investment. After the war, questions were debated regarding the political future of Newfoundland. A series of public referendums culminated in Newfoundland joining Canada through Confederation in 1949.

Confederation brought immediate benefits to Newfoundland, a new province which lagged behind many regions of Canada in terms of social and economic development. Federal transfer payments such as welfare and family allowance, equalization funds for social services and infrastructure, and regular federal departmental expenditures were significant benefits. However, Confederation was a two-edged sword. Newfoundland was required to remove customs duties and tariffs on goods imported from other provinces. Given Newfoundland's small domestic market and high transportation costs for imported raw materials, many industries could not survive mainland competition. The effects were most noticeable in the agriculture and consumer goods manufacturing industries. The 1950's saw several failed attempts to revive manufacturing and finally a return to an economy based upon natural resources.

In the 1960's, the Newfoundland government sought to expand the economy and the province's level of industrialization through a series of large resource development projects. These projects were initiated using a combination of direct government investment and attractive tax and resource rent terms for the participating partners. Some projects like the Churchill Falls hydro-electric station have operated profitably but at the cost of massive public debt and foregone tax and resource rent revenues. Others, like the Stephenville pulp and paper mill, were eventually sold to private industry after years of government subsidization and economic losses. There were also developments such as the Come-By-Chance oil refinery which failed completely after substantial government investment and operating subsidies. While the government strategy of pursuing economic growth through major resource based developments was no different than in other provinces, Newfoundland suffered many failures. The costs of maintaining many of these projects often exceeded the total direct and indirect economic benefits. More importantly, these failed developments contributed heavily to Newfoundland's current dificulties with its public debt load.

2.3.2 Social Indicators

A comparison of key social indicators between Newfoundland and Canada is useful to illustrate any disparity in the quality of life (Table 5). On the positive side, Newfoundland has a low population density and a population growth rate relatively equal to the Canadian average. The province also enjoys lower rates for divorce and suicide. While housing tends to be more crowded, the rate of home ownership in the province is quite high. Finally, the Newfoundland crime rate is far below the national average.

On the negative side, the provision of health care and levels of education are much lower in Newfoundland. Thus, the province experiences differences in either direction for social indicators when compared to a national average. While a healthy lifestyle may exist in the province, there are deficiencies in certain social services.

TABLE 5

Social indicators, Canada and Newfoundland, for selected years[a].

Social Measure		Canada	Newfoundland
1. Demography (1979)			
Population		23,671,500	574,000
Population density/km^2		2.57	1.55
Population growth rate	1966-71(%)	7.8	5.8
	1971-76(%)	6.6	6.8
	1976-79(%)	2.9	2.9
Birth rate/1000 population		15.1	18.6
2. Health/1000 Population (1977)			
Infant mortality/1000 live births		14.3	15.7
Marriages		8.6	6.9
Divorces		2.4	0.8
Suicides		0.14	0.04
Physicians		1.7	0.7
Dentists		0.4	0.2
3. Education (1977/78)			
Proportion of 18-24 age group in post-secondary school (%)		19.6	11.3
Expenditure on education/capita($)		741.76	609.83
4. Housing (1976)			
Crowding index (persons per room)		0.58	0.74
Ownership rate (%)		61.8	80.9
5. Crime Rate/100,000 Population (1978)			
Murders		2.8	1.6
Robberies		84.6	9.4

[a]Source: (Economic Council of Canada, 1980).

2.3.3 Economic Indicators

Of equal importance to social indicators are economic indicators in measuring any disparities between Newfoundland and the nine other provinces. An evaluation of several key economic indicators (Table 6), shows that Newfoundland's economic performance lags far behind the Canadian average.

TABLE 6

Economic indicators, Canada and Newfoundland, for selected years[a].

Economic Indicator	Canada	Newfoundland
1. Unemployment Rate (1983) (%)	11.9	18.9
2. Personal Income (1983)		
per capita ($)	13,448	8,957
from Government transfers (%)	14.9	29.9
3. Gross Domestic Product per Capita (1981)($)	15,616	8,637
4. Value of Manufacturing Shipments per Capita (1981)($)	7,956	2,179
5. Provincial Debt as Percentage of Personal Income (1978)(%)	39.6	81.2

[a]Source: (Anon., 1984b; Anon., 1984c; Economic Council of Canada, 1980).

The average unemployment rate in Newfoundland has consistently been higher than in other regions of Canada since the province joined Confederation in 1949. There are many reasons for this trend, including a weak economic structure, high wage rates relative to labour productivity, a dependence upon cyclical and seasonal industries, and the attractiveness of government income maintenance programs (Flatters, 1981; Zuker, 1981). The unemployment rates in Table 6 are official Statistics Canada compilations. To be included in these statistics, an individual must satisfy one of the following criteria;

- the individual must be actively looking for work, or
- be available for employment but on layoff for less than 26 weeks, or
- be available for work and have a new job starting within four weeks.

(Economic Council of Canada, 1980)

In many rural areas of Newfoundland, employment opportunities are scarce. As a result, some individuals become discouraged in their search for work and do not register with the local government employment office. Therefore, in many communities, unofficial unemployment may be several times greater than official statistics indicate.

Personal income per capita in Newfoundland is only 67 percent of the Canadian average. While wage rates in the province are comparable to many other regions in the country, the per capita income is much smaller when averaged over a population with such high unemployment. Another contributing factor is that close to one-third of total personal income in Newfoundland is derived from government transfer payments such as welfare, pensions, unemployment insurance and family allowance. This figure is more than twice the national average.

The weak economic base of the province is reflected both by the low Gross Domestic Product (GDP) and value of manufacturing shipments per capita relative to the national average. The low figure for Newfoundland's GDP per capita is indicative of low incomes and an economy with a limited manufacturing base for high valued products. In Newfoundland, manufacturing contributes approximately 12 percent to GDP, only one-half the national average. The provincial economy is instead dominated by the service sector which provides few opportunities for export earnings.

The most important statistic from Table 6 is the provincial government debt as a percentage of personal income. The figure for Newfoundland is twice the Canadian average and is also the highest of all 10 provinces. The current public debt in Newfoundland exceeds $3.7 billion, equivalent to $6,231 per capita. This government debt, which has increased nearly 275 percent since 1972, is a severe constraint on its fiscal capability. At present, expenditures related to debt servicing account for one-third of total government revenue from provincial sources. This situation is ameliorated somewhat through federal transfers such as equalization payments which are approximately equal to total provincial revenues. Therefore, the Government of Canada is financing roughly one-half of Newfoundland's annual budgetary expenditures (Anon. 1983a). This fact more than any, underlines the weakness of the Newfoundland economy and its inability to generate adequate government revenues. One should note that the tax regime in Newfoundland is the highest in Canada and has been identified as a constraint to economic growth (Economic Council of Canada, 1980). From the same report, factors such as low productivity in some sectors, lack of technology transfer, the Island's isolation relative to mainland markets, and a widely dispersed population which dilutes social capital, were also cited as constraints to economic development.

In summary there is a large regional disparity between Newfoundland and the rest of Canada as represented by a mix of social and economic indicators. Since 1949, the province has made significant gains in improving the standard of living for its people. However, the lag in economic performance and in some social services remains substantial.

2.3.4 The Structure of the Newfoundland Economy

The domination of Newfoundland's economy by service producing sectors is illustrated in Table 7. The economy is grouped by sector according to GDP output and employment for 1980, the last year in which complete data were available.

TABLE 7

The structure of the Newfoundland economy, 1980.[a]

Economic Sector	GDP ($000,000)	% of Total	Employment (person-years)	% of Total
Goods Producing				
Primary	642.4	17.6	43,300	24.6
Manufacturing	424.8	11.6	18,200	10.3
Construction	270.0	7.4	8,300	4.7
Electric Power-Utilities	212.9	5.8	2,500	1.4
Sub-Total	1,550.1	42.4	72,300	41.0
Service Producing				
Transportation and Communication	383.8	10.5	16,900	9.6
Trade	371.2	10.1	23,300	13.1
Finance, Insurance and Real Estate	240.4	6.6	5,100	2.9
Community, Business and Personal Services	765.5	20.9	44,900	25.5
Public Administration	348.0	9.5	14,000	7.9
Sub-Total	2,108.9	57.6	103,900	59.0
Total Goods and Services Sectors	3,659.0	100.0	176,200	100.0

[a]Source: (Anon., 1981c; Anon., 1984c) and various statistics compiled by the Newfoundland Forestry Centre, St. John's.

The major components of the goods producing sector are primary and manufacturing industries. Primary industries include agriculture, fishing, logging and mining. Of these four industries, fishing dominates employment with more than 80 percent of the total primary employment. For GDP however, mining is most important with 73 percent of the total primary GDP. Logging activities associated with the forest industry assume a relatively minor role in the primary sector.

Manufacturing includes a wide range of industries, from chemicals to foodstuffs. The fish processing industries account for approximately one-half of total manufacturing employment. The second most important industry is forestry processing which contributes nearly one-quarter towards the total. In terms of GDP output, forestry and fish processing are roughly equivalent as the major contributors.

On a broader basis, the goods producing sector of the Newfoundland economy centres around mining, fishing and forestry; all resource based industries. While opportunities for expansion and growth are limited in these industries, the recent development of a petroleum industry may provide scope for further economic gains in the goods producing sector (Economic Council of Canada, 1980). Exploration for hydrocarbons on the Grand Banks of Newfoundland began in 1964. In 1979, a commercial field of oil and gas was discovered by a consortium of companies involved in exploration. At the present time, exploration is continuing. Actual production of oil and gas may not occur for several years. These petroleum deposits are high-cost sources which will require significantly higher oil prices than presently exist in order to assure industry profitability. In addition there are many questions regarding technical feasibility of extraction, government revenue-sharing, tax treatment and production regulations, to be addressed. Eventual petroleum production will transfer significant benefits to Newfoundland, however, the industry will not solve all the province's economic problems (Wilby, 1981). Therefore, while the petroleum industry may become an important economic force, the provincial goods producing sector will still centre around mining, fishing and forestry.

The service producing sector of the Newfoundland economy is important in terms of employment and contribution to provincial GDP. There are however, limitations to growth in the service sector for several reasons. First, growth in service industries is closely tied to output in goods producing industries. As stated earlier, there are limited growth opportunities in the goods producing sector, aside from the petroleum industry. Second, service industries generally do not have a strong potential for export earnings (Economic Council of Canada, 1977). This situation is exacerbated by Newfoundland's isolated geographic position. Third, opportunities for domestic growth in urban centres are restricted by the small provincial population and absence of major cities.

In summary, the province of Newfoundland appears to have limited opportunities for significant growth in the near future. Thus, the gap in many social and economic indicators between Newfoundland and Canada will likely continue. The dependence upon federal transfers both for personal income of Newfoundlanders, and in meeting the provincial government's budgetary requirements will remain strong. The high level of provincial government debt and inability of the economy to generate sufficient public revenues are fundamental problems of the Newfoundland economy. Resource-based industries such as mining, fishing and forestry are key components of the goods producing sector. These industries also greatly influence the level of output in the service producing sector. From a medium to long-term outlook, the emerging offshore petroleum industry may hold some promises of future economic growth and generation of public revenues.

2.4 THE NEWFOUNDLAND FOREST INDUSTRY

There are three separate commercial segments which comprise the forest industry in Newfoundland; logging, wood industries and, the pulp and paper industry. In addition, there is a large requirement for domestic fuelwood in the province. While not a commercial industry, domestic fuelwood is a major component of softwood consumption and therefore merits discussion. In this section, each of the forest industry segments, including domestic fuelwood, will be described in terms of historical development, current structure and wood consumption, products, and future outlook.

2.4.1 Wood Industries

The wood industries sector is comprised of sawmills and planing mills, and miscellaneous woodworking plants.

a. Sawmills and Planing Mills

1. History

Sawmills have long been a part of Newfoundland's rich historical background. The first sawmill recorded in the province was built in the early 1600's on the eastern coast to supply Sir John Guy's colony at Cupids, the first English colony in the New World (Gray, 1981). Over the next 200 years, many sawmills were constructed in coastal areas to supply lumber to fishing communities. By 1884, there were 55 sawmills in the province producing approximately 27,000 m^3 of lumber annually. The industry gradually expanded over the next twenty years; by 1904 there were over 190 sawmills with annual lumber production of nearly 103,000 m^3. This expansion was based upon a large export market for white pine lumber, however by 1912, the industry began to decline for several reasons. First, the large stands of white pine were becoming more scarce and inaccessible. Second, log quality was poor with a high cull factor of 35 to 40 percent (Poole *et al.*, 1981a). Third, recently established pulp and paper interests were acquiring large areas of timber limits in the Island's interior. The decline in production continued until the Second World War, however, the number of sawmills increased to nearly 1000, indicating reductions in mill size and capacity. Thus, the industry was changing from an export oriented sector with a limited number of large mills, to a sector composed of mainly small, portable "push-bench" mills serving domestic markets.

During the Second World War and throughout the 1950's, production levels increased, mainly in response to construction associated with Allied military activity on the Island. In the mid 1950's, annual lumber production reached a record level of 141,000 m^3. Also, throughout this period the number of sawmills increased to over 1600, again mainly in the small push-bench category.

A second period of decline took place during the 1960's with production falling to 60,000 m^3 of lumber, and the number of mills dropping to approximately 1000 by 1968. Up to 1981, production increased to an average of approximately 88,000 m^3 with fluctuations in either direction, depending upon market conditions. The number of mills however, increased to approximately 1700, with the major expansion in the smaller mill classes.

2. Current Structure, Output and Wood Consumption.

The Newfoundland sawmill industry has evolved into a manufacturing sector serving domestic markets (Milne, 1984b). The structure of the industry has adapted to meet local conditions such as small timber size, limited areas of unalienated Crown forests, and a preference in many rural areas to include sawmilling as only one form of seasonal employment.

The nearly 1700 sawmills licenced in 1981 produced a toal of 90,088 m^3 of rough lumber (Table 8). An estimated 42 percent of rough lumber output, or 37,873 m^3, were planed and sold as dressed lumber. These sawmills are widely distributed throughout the province. In 1981, there were 1605 mills on the Island, mainly operating on unalienated Crown forests in coastal areas. The 74 mills in Labrador were concentrated in the Goose Bay-Happy Valley region. An estimated 184,000 m^3 of roundwood were consumed by the industry in the production of lumber, all of which originated from Newfoundland forests.

TABLE 8

Rough lumber production in Newfoundland, 1981.[a]

Mill Production Class	Total Production (m^3)	Share of Production (%)	No. of Mills in each class	$\bar{x}$ Production Per Mill (m^3)
1. < 24m^3	10765	12	1229	8.8
2. 25 to 59m^3	9779	11	192	50.9
3. 60 to 118m^3	12784	14	110	116.2
4. 119 to 177m^3	5818	6	40	145.5
5. 178 to 236m^3	9167	10	45	203.7
6. 237 to 1180m^3	28401	32	55	516.4
7. > 1180m^3	14174	16	8	1771.8
Total	90088	100	1679[b]	53.7

[a]Source: (Milne, 1984b)
[b]Does not include 62 mills which did not submit a provincial sawmill licence return.

Of the 90,088 m^3 of lumber processed in 1981, approximately 78 percent, or 70,268 m^3 were sold commercially. The remainder was accounted for through custom work and personal consumption by the sawmill owner. Custom work involves a mill sawing or planing lumber for individuals supplying the raw material. Payment can be in the form of cash, a traded service or a portion of the finished product. Personal consumption involves a mill operator sawing or planing lumber for his own use such as in a house, fencing, outbuildings, wharves and boats. Lumber produced in Newfoundland is marketed entirely within the province. Local production however, serves approximately 40 percent of the domestic market with imports making up the difference. Given the smaller log size in Newfoundland, large dimension lumber must be imported.

3. Economic Impacts and Future Outlook

The major economic impacts of the industry are summarized in Table 9. While there are no individual mills large enough to sustain the economy of a single community, there are regions in the province where concentrations of mills can generate substantial benefits (Milne, 1982). In many rural areas of Newfoundland, the sawmill and planing mill industry is an important source of employment and income.

TABLE 9

Economic impacts of the Newfoundland sawmill and planing mill industry, 1981.[a]

Economic Indicator	Impact
a. Direct employment (person-years)	1,356
b. Indirect employment (person-years)	542
c. Direct income ($)	5,236,800
d. Indirect income ($)	1,832,900
e. Capital expenditures ($)	1,363,300
f. Operational expenditures ($)	2,923,800
g. Value added ($)	3,517,800
h. Value of shipments ($)	8,808,700

[a]Source: (Milne, 1984b)

The long-term outlook for the industry is unclear. There appears to be considerable scope for replacement of smaller dimension lumber imports with local production, perhaps by as much as 28,000 m^3. The industry has sufficient slack operating capacity at present to manufacture this extra volume. A major constraining factor however, is the adequacy of sawlog supplies in view of recent budworm losses. Substantial investments to increase sawlog supplies may be required as part of a long-term government strategy. Associated problems to be addressed include limiting mill expansion in certain areas, controlling illegal cutting on unalienated Crown lands, and improving harvesting utilization.

b. Woodworking Industry

1. History

The Newfoundland woodworking industry has a fairly recent history. Types of plants included in the industry are:

- cabinet manufacturers
- wooden door and window plants
- casket makers
- toy manufacturers
- furniture construction
- ship and boat building
- roof truss, mobile trailer and floor truss plants.

With the exception of boat building, the majority of commercial woodworking plants evolved from the economic activity associated with military expenditures during and after the Second World War. The industry has declined in scale since the mid-1950's although there are signs of this trend being reversed. For example, from 1957 to 1977, the number of establishments as measured by Statistics Canada, decreased from 42 to nine. By 1981, there were 18 firms listed in these published data.

2. Current Structure, Output and Wood Consumption

In 1982, a survey conducted by the Newfoundland Forestry Centre (NFC) found the woodworking industry to consist of 92 firms, compared to the 18 which were represented by Statistics Canada data (Milne and Mallay, 1984). The NFC survey indicated a wide variation in plant size according to wood consumption. Forty-seven percent of the firms used less than 24 m^3 of wood input annually, 33 percent used from 24 to 142 m^3, while 20 percent consumed more than 142 m^3 each year. The majority (39 percent) of businesses were located in or near St. John's, serving the urban market. The remaining firms were distributed throughout the province, mainly near larger communities.

The industry produces a wide range of products, from wooden toys selling for under $20.00, to large longliners valued at $500,000.00. The most common products however, are wooden cabinets, windows and doors. In 1981, an estimated 29,000 m^3 of wood input was consumed, of which 97 percent were lumber and three percent panel products. Overall, close to 80 percent of this wood input was imported reflecting the lack of local kiln dried lumber and requirements for non-indigenous hardwoods such as oak and walnut.

Virtually all of the industry's output is sold in the Newfoundland market. Only a small quantity of wooden toys and fine furniture are exported to mainland markets. Within the province, approximately two-thirds of the manufactured products are sold in market areas less than 50 km from the plant. Therefore, the industry is highly geared to local community markets.

3. Economic Impacts and Future Outlook

The woodworking industry can be described as a small sector producing a high valued output and yielding above average incomes to a small labour force (Table 10). As with the sawmill industry, few if any woodworking plants are large enough individually to sustain a community's economy. However, the plants do make a significant contribution to employment and income, especially in rural areas.

The industry has considerable scope for expansion through import substitution in a wide range of finished wood products. There have been recent efforts by industry and government to address problems of technology transfer and the lack of economical kiln drying equipment. There is also a major opportunity to increase the utilization of local birch as a raw material for many products. Such a development would ultimately benefit the sawmill industry as well.

TABLE 10

Economic impacts of the Newfoundland woodworking industry, 1981.[a]

Economic Indicator	Impact
a. Direct employment (person-years)	521
b. Indirect employment (person-years)	276
c. Direct income ($)	9,441,900
d. Indirect income ($)	3,776,800
e. Capital expenditure ($)	113,200
f. Operational expenditure ($)	7,574,700
g. Value added ($)	20,753,600
h. Value of shipments ($)	33,767,800

[a]Source: (Milne and Mallay, 1984)

2.4.2 Pulp and Paper Industry

1. History

Of the 12 attempts at developing large pulp and paper mills in Newfoundland only three have succeeded. Presently, there are newsprint mills in Corner Brook, Grand Falls and Stephenville on the Island (Poole *et al.*, 1981a). The Corner Brook mill, established jointly by the Reid Newfoundland Co. and a British firm, Whitworth Co., began operation in 1925 (Gray, 1981). Initial mill capacity was approximately 127,000 tonnes per year. In 1938, the Bowater Corporation of Great Britain acquired the mill, and by 1979 had increased capacity to 363,000 tonnes. As a response to declining markets and a world recession, in 1983 Bowater permanently closed the mill's largest paper machine with a resulting loss in capacity of nearly 80,000 tonnes. Following a corporate reorganisation of its international newsprint production, Bowater sold the mill to a Canadian firm, Kruger Co. of Montreal, in late 1984. At present, the mill is undergoing significant modernization to improve productivity and increase efficiency.

The Grand Falls mill began production in 1909 under ownership of the Anglo-Newfoundland Development Co.. The initial mill capacity was 27,000 tonnes per year. By 1925, capacity had increased to approximately 91,000 tonnes (Munro, 1978). By 1979, the current mill owners, Abitibi-Price, had increased mill capacity to nearly 270,000 tonnes. However, in 1983, the company reduced capacity by approximately 30,000 tonnes when an older and smaller paper machine was shut down. On a more positive note, the company has planned future capital investments which would increase mill capacity to nearly 300,000 tonnes per year.

The newsprint mill at Stephenville has a relatively young history. The operation began in 1973 as a linerboard mill after four years of construction plagued by delays and cost overruns. These problems were of such a serious nature that the provincial government assumed control over the mill through a Crown corporation. The linerboard mill operated only until 1977, when it was closed on account of poor markets and high costs of wood input from Labrador (Gray, 1981). In 1978, the mill was sold to Abitibi-Price who then converted the plant to newsprint production. The mill began operation in 1981 with a capacity of approximately 150,000 tonnes annually. There are tentative plans to add a second paper machine which would nearly double existing capacity, however no firm decisions or dates have been established.

2. Current Structure, Output and Wood Consumption.

The current industry structure of three newsprint mills was briefly described in the previous section. Total industry capacity was reduced from nearly 780,000 tonnes to approximately 670,000 tonnes in 1983 through paper machine closures at the two older mills. Consequently, newsprint production has declined from a high of 650,000 tonnes in 1981 to less than 550,000 tonnes in 1983 (Anon. 1984c).

On a solid volume basis, the three mills consumed a total of 1.5 million m^3 of softwoods in 1983. The industry prefers to process black spruce as primary mill furnish due to its superior fibre qualities for paper manufacturing. However, approximately 50 percent of current mill input is balsam fir, stemming from the need to salvage budworm-killed fir stands prior to deterioration of the wood. Budworm-caused mortality in balsam fir has impacted heavily upon the paper companies through increased protection costs, more expensive salvage logging and reorganization of planned harvesting schedules.

Until recently, the largest market for Newfoundland newsprint has been the United States, accounting for approximately 40 percent of total production. Of the remainder, 50 percent was normally split between the EEC market and South and Central America. The remaining 10 percent was shipped to other countries (Anon., 1984c; Anon., 1981b). Since 1980 however, the market ratios have changed considerably due in part to the marketing strategies of the parent companies of the Newfoundland mills. Recent trends indicate a heavier reliance on the EEC for newsprint produced in Newfoundland while other company mills on the mainland market their paper in the Northern and Southern American continents. This strategy has placed Newfoundland mills in direct competition with European newsprint producers. While the Stephenville operation is highly efficient, the outdated capacity at the two older mills is a disadvantage. The weakness of the Canadian dollar has been an ameliorating factor, and planned capital investments in the older mills should create a more stable trading advantage.

3. Economic Impacts and Future Outlook.

The newsprint industry is a major sector of the Newfoundland economy. The main economic impacts are presented in Table 11. Indirect employment is estimated using a multiplier of 2.40. This value is an estimate based on examination of employment multipliers used in other studies of the forest industry (Anon., 1981a; Reed *et al.*, 1973; Ondro and Williamson, 1982; Runyon *et al.*, 1972). In these other studies, employment multipliers for pulp and paper industries ranged from 2.43 to 3.50. In a similar manner, an income multiplier of 1.40 is estimated from studies of income generation in the forestry sector (Carroll and Milne, 1982; Greig, 1971; Brownrigg, 1971; Runyon *et al.*, 1972). Income multipliers in these studies ranged from 1.24 to 1.54. The indirect benefits of employment and income are regional estimates for the entire province. The multipliers developed for Newfoundland are lower than similar multipliers in many of the referenced studies. This adjustment accounts for the lack of a highly diversified economic base in the province and the relatively high leakage of income out of the economy.

TABLE 11

Economic impacts of the Newfoundland pulp and paper industry, 1981.

Economic Indicator	Impact
a. Direct employment[a] (person-years)	2,981
b. Indirect employment[b] (person-years)	4,173
c. Direct income[b] ($)	73,750,000
d. Indirect income[b] ($)	29,500,000
e. Capital expenditures[b] ($)	34,000,000
f. Operational expenditures[a] ($)	131,257,000
g. Value added[a] ($)	194,049,000
h. Value of shipments[b] ($)	330,425,000

[a]Source: (Statistics Canada 25-202, 1982)
[b]Source: Author's estimates

Capital expenditures are estimated from an analysis of expenditures during the period 1970 to 1979. In this time frame, the two older mills invested $140 million, or $14 million on an annual average basis. This figure is used in Table 11 for these two mills. In addition, a total of $60 million was invested in the Stephenville mill from 1979 to 1981 during reconstruction, or $20 million per year on an average basis. Therefore, an estimate of $34 million is used in Table 11 for capital expenditures in 1981.

While the newsprint mills are important to the provincial economy generally, their contribution to income and employment is more apparent on an community basis. Each mill is the dominant economic force in the communities of Corner Brook, Grand Falls and Stephenville. Given the reductions in mill capacity in 1983 at Grand Falls and Corner Brook, the level of economic activity at present will be somewhat less than in Table 11 for 1981. However, the industry still generates substantial economic benefits.

The long-term outlook for the Newfoundland newsprint industry is positive, considering the major modernization program currently underway in Corner Brook, and planned for Grand Falls. With virtually 100 percent of

Newfoundland produced newsprint exported, the competitive position of its three mills is a critical factor in long-term growth. One potential constraint to growth over the next few decades may be the increasing scarcity of low-cost, high quality softwood pulp stands due to budworm mortality. Current intensive management programs will reduce the impact of budworm losses, but only after several decades, when the new stands are of merchantable volume.

2.4.3 Logging Industry

Activity in the logging industry is closely tied to production in the sawmill and newsprint industries. Approximately 87 percent of commercial logging production is accounted for by the woodlands operations of the newsprint companies (Milne, 1984a). The sawmill industry accounts for a further 11 percent, while the remaining two percent is for minor volumes cut for use in the woodworking industry.

Commercial logging ouput in 1981 was approximately 2,127,000 m^3, according to Statistics Canada data. In 1983 total commercial production declined to 1,788,200 m^3, reflecting reductions in newsprint capacity and a decrease in lumber output due to the economic recession. Since 1977, a small quantity of pulpwood has been exported, amounting to slightly over two percent of total commercial logging production.

The economic impacts associated with the commercial logging industry are presented in Table 12. Indirect employment and income are estimated using appropriate multipliers used in other studies (Runyon *et al*, 1972; Ondro and Williamson, 1982; Carroll and Milne, 1982). For Newfoundland, an employment multiplier is estimated at 1.50, while for income, a multiplier of 1.40 is used. There is an apparent lack of published data on capital and repair expenditures in Newfoundland, however estimates can be derived indirectly. In 1981, the total value of capital and repair expenditures in the four Atlantic provinces including Newfoundland, was $36,400,000 (Anon., 1984a). Based on an average of Newfoundland's share of logging employment, value of shipments and roundwood production from the total of the four provinces, the percentage of Newfoundland's capital and repair expenditures can be estimated. Assuming the two ratios are equivalent, capital and repair expenditures in Newfoundland's logging industry were approximately 21 percent of the regional total, or $7,600,000.

TABLE 12

Economic impacts of the Newfoundland commercial logging industry, 1981.

Economic Indicator	Impact
a. Direct employment[a] (person-years)	1,580
b. Indirect employment[b] (person-years)	790
c. Direct income[a] ($)	33,254,000
d. Indirect income[b] ($)	13,301,600
e. Capital expenditures[b] ($)	7,600,000
f. Operational expenditures[a] ($)	40,878,000
g. Value added[a] ($)	52,324,000
h. Value of shipments[a] ($)	89,422,000

[a]Source: (Statistics Canada 25-202, 1982)
[b]Source: Author's estimates

Given the strong linkage between the newsprint and logging industries, the communities of Corner Brook, Grand Falls and Stephenville likely receive the majority of economic benefits from logging actively. This linkage also means that growth in the logging sector is largely dependent upon expanded wood requirements for the newsprint industry.

2.4.4 Domestic Fuelwood

The use of wood as a source of home heating energy has increased dramatically in the past decade in response to escalating costs of electricity and fuel oil. In 1983, there were 65,451 wood-burning households on the Island, or 46 percent of all Island households (Northlands Associates, 1984). An estimated 820,000 m^3 of fibre were burned in 1983, an increase of 168 percent from 1978 consumption. Approximately 73 percent of the fibre, or 597,000 m^3

were softwoods. While a proportion of this softwood was composed of sawmill waste and timber cut from non-commercial "scrub" stands, no data are available on exact percentages. Therefore, the 597,000 m^3 of softwoods does not represent a true estimate of the drain on commercial softwood stands for fuel.

The use of fuelwood as an alternative energy source is widespread throughout the Island. The majority of wood-burning households (87 %) cut their own fuelwood each year. The expenditures by individuals cutting domestic fuelwood, mainly for fuel and oil can only be estimated. From an analysis of Statistics Canada data on logging, and a study of costs incurred by sawmills for logging (Milne, 1984b), domestic fuelwood cutters spent an estimated \$3.60 per m^3 on wood procurement. This figure includes expenditures for fuel, chain oil and maintenance of chainsaws and pick-up trucks. Therefore, the total cash outlay in 1983 was approximately \$2.6 million. For people purchasing fuelwood, an estimated \$2.0 million was paid to commercial fuelwood contractors. The resulting total cash injection into the Island's économy in 1983 was an estimated \$4.6 million.

The long-term trend in fuelwood consumption would appear to be in an upward direction as Newfoundlanders strive to reduce their domestic heating costs. In addition, the use of wood energy by commercial facilities such as fishplants, and government institutions (schools, offices etc.) could also increase. Heating costs in Newfoundland, using fuel oil or electricity are among the highest in Canada, and growth in fuelwood consumption is closely tied to pricing trends in these two energy sources.

2.5 SUMMARY OF WOOD SUPPLY AND DEMAND

Softwood consumption in Newfoundland for 1983 was approximately 2.4 million m^3 (Table 13). The newsprint sector accounted for 65 percent of the total, with domestic fuelwood comprising a further 25 percent. Softwood requirements for sawmills and miscellaneous uses make up the remaining 10 percent. Virtually all softwood consumption occurs on the Island, with the exception of less than 4,000 m^3 utilized by sawmills in Labrador. To put this figure in perspective, Labrador sawmills produce less than two percent of the provincial lumber output. Therefore, despite the rather significant forest resource base in Labrador, only minor utilization occurs. Constraints which limit expanded forest industry activity include a lack of existing infrastructure, a short ice-free shipping season and the long distance to markets for timber outputs. At present, the provincial government is promoting the region in hopes of attracting a major forestry development such as a fibreboard or pulp and paper mill.

TABLE 13

Estimated softwood consumption, Newfoundland 1983.[a]

Softwood User	Volume Consumed (m^3 solid)	% of Total Consumption
1. Sawmills and Planing Mills	192,600	8
2. Domestic Fuelwood	596,925	25
3. Miscellaneous	48,000	2
Sub-Total: Non-newsprint	837,525	35
4. Grand Falls	523,800	22
5. Stephenville	337,500	14
6. Corner Brook	686,300	29
Sub-Total: Newsprint mills	1,547,600	65
Total	2,385,125	100

[a]Source: (Milne, 1984a)

The distance between Labrador and the major wood consuming regions of Stephenville, Corner Brook and Grand Falls precludes the shipment of roundwood from Labrador to the Island. As an example, during the short operating period of the linerboard mill in Stephenville, wood was shipped from Labrador to augment limited supplies from the Island. In 1976, wood costs from Labrador were $105.60 per cord, or twice the expected costs for wood from the Island (Gray, 1981). Future increases in wood consumption in Labrador therefore are tied to expanded industry activity in the region itself rather than on the Island.

For the Island, softwood consumption could increase from the present level of 2.4 million m^3 to 4.1 million m^3 by the year 2040 under optimistic growth assumptions (Milne, 1984a). The AAC projection of 3.0 million m^3 in the recent Royal Commission report (Poole, *et al.* 1981a) indicates that future softwood deficits are possible. As explained earlier in this chapter however, there are several factors which have continued to influence AAC since 1980. Until the Provincial Forestry Service can provide more recent and accurate AAC projections, no definite conclusions can be drawn regarding softwood supply and demand.

The volume of hardwoods consumed in the province is small, consisting mainly of fuelwood burned by domestic users, and hog-fuel at the two older newsprint mills. The total consumption of hardwoods in 1983 was approximately 200,000 m^3 (Northlands Associates, 1984; Poole *et al,* 1981a). There is also a small amount of hardwood lumber produced each year requiring approximately 5,000 m^3 of roundwood. The current hardwood AAC of 737,000 m^3 for Newfoundland indicates that current fibre requirements can be met (Anon., 1984a). The distribution of hardwoods between Labrador and the Island, as well as the economic availability, quality and size of the stands is unclear from the available data. No definite conclusions regarding long-term supply and demand trends for hardwoods are possible at present.

2.6 IMPORTANCE OF FORESTRY TO THE NEWFOUNDLAND ECONOMY

The main economic impacts of the forest industry in Newfoundland are summarized in Table 14. Clearly, the pulp and paper mills are the most important sector in the Newfoundland forest industry. If one includes logging activity by the newsprint mills, the pulp and paper sector generates two-thirds of total direct employment, 84 percent of direct income, 92 percent of capital and operational expenditures combined, 89 percent of value added, and 88 percent of value of shipments.

TABLE 14

Economic impacts of the Newfoundland forest industry, 1981.[a]

Economic Indicator	Industry Sector				Total
	Logging	Sawmilling	Wood-working	Pulp-Paper	
Direct Employment (person-years)	1,580	1,356	521	2,981	6,438
Indirect Employment (person-years)	790	542	276	4,173	5,781
Direct Income ($000,000)	33.2	5.2	9.4	73.8	121.7
Indirect Income ($000,000)	13.3	1.8	3.8	29.5	48.4
Capital Expenditures ($000,000)	7.6	1.4	0.1	34.0	43.1
Operational Expenditures ($000,000)	40.9	2.9	7.6	131.3	182.6
Value Added ($000,000)	52.3	3.5	20.8	194.0	270.6
Value of Shipments ($000,000)	89.4	8.8	33.8	330.4	462.4

[a]Source: Summary of Tables 9, 10, 11, 12

Overall, the forest industry contributes more than six percent to total provincial GDP, two-thirds of which is due to newsprint manufacturing. The forest industry also generates four percent of the total direct employment and five percent of total direct wages and salaries in the province. Adding indirect employment and income enhances the contribution of the forest industry to the provincial economy.

A further economic impact is the generation of public revenues. Using methods applied in an earlier study (Milne, 1981b), tax revenues paid to federal and provincial treasuries in 1981 by the forest industry and employees were an estimated $27.3 million and $43.1 million respectively. In addition, the province collected approximately $520,000 in forestry fees such as stumpage, cutting permits and sawmill licences.

In terms of regional development, the forest industry provides socio-economic benefits in many rural areas where alternative opportunities for employment and income may be limited. Out of 403 municipalities in Newfoundland, 81 have at least 10 percent of their experienced labour force engaged in forestry work.

Forestry's impact upon the economy is perhaps most noticeable in the provincial manufacturing sector. Forestry processing accounts for approximately one-quarter of total manufacturing employment, income and value of shipments. In addition, newsprint shipments account for one-half of the total value of exports from the province. On a broader scale these exports earn valuable foreign exchange for Canada since virtually all newsprint production from Newfoundland is sold outside the country.

2.7 THE NEWFOUNDLAND FOREST INDUSTRY COMPARED TO CANADA'S FORESTRY SECTOR

The Newfoundland forest industry is overshadowed by other provinces such as British Columbia where the industry structure and output are far greater (Table 15).

In terms of roundwood production, Newfoundland contributes 1.8 percent to the national total, ranking eighth out of eleven (10 provinces plus combined Yukon and N.W.T.). Of interest, British Columbia, Quebec and Ontario account for 81.5 percent of the total roundwood production in the country.

Based on value added from the forest industry, Newfoundland contributes 2.1 percent of the Canadian total. This figure ranks seventh out of eleven. Again, the three primary forestry provinces of British Columbia, Quebec and Ontario dominate with 84.5 percent of total value added.

TABLE 15

Roundwood production and value added in the Canadian forest industry, 1981.[a]

Province	Roundwood Production ($000m^3$)	% of Canadian Total	Value Added ($000,000)	% of Canadian Total
British Columbia	60,780	42.0	3,661	29.8
Quebec	34,234	23.7	3,640	29.6
Ontario	22,808	15.8	3,083	25.1
New Brunswick	7,795	5.4	529	4.3
Alberta	6,586	4.6	467	3.8
Nova Scotia	3,986	2.8	303	2.5
Saskatchewan	3,555	2.5	149	1.2
Newfoundland	2,568	1.8	259[b]	2.1
Manitoba	1,803	1.2	201	1.6
Prince Edward Isle.	333	0.2	2	-
Yukon-N.W.T.	124	0.1	1	-
Total Canada	144,572	100.0	12,295	100.0

[a]Source (Anon., 1984a)
[b]The value added figure is from Statistics Canada and differs slightly from the figure in Table 14. This is because Statistics Canada omits many small firms in their surveys in Newfoundland.

Incomplete national statistics prevent a more thorough comparison using employment, income and value of shipments. However, the data in Table 15 clearly show that in terms of roundwood production and value added, Newfoundland's forest industry makes a minor contribution to the national totals.

Another method of comparing the forestry sector of Newfoundland with other regions in Canada is in terms of selected statistics on a per m^3 of production basis. In this manner, the relative importance and value of forestry in each province can be compared (Table 16). The provinces and the territories are listed in order by the volume of roundwood produced in 1981. An examination of value added per m^3 of production reveals a wide difference from the original ranking. For logging, Newfoundland has the highest value added per m^3, while for manufacturing, the province ranks fourth. Overall, Newfoundland also ranks fourth, behind Ontario, Manitoba, and Quebec. Value added is an indication of an industry's contribution to GDP and is a useful criterion for determining the economic contribution of the forest industry (Ondro and Williamson, 1982). The high value added per m^3 for logging in Newfoundland may reflect comparatively lower logging costs and the fact that the two older newsprint mills do not pay stumpage charges to the province. Overall, the high ranking for Newfoundland may be partially due to the dominance of high valued newsprint in the mix of manufactured forest products. This reason would also apply to Manitoba, Quebec and Ontario.

TABLE 16

Value added per m^3 production and contribution of forestry to GDP by province, 1981.[a]

Province	Value Added per m^3 ($)			Forest Sector Contribution to Provincial GDP(%)
	Logging	Manufacturing	Total	
British Columbia	14.29	45.92	60.21	9.1
Quebec	11.67	94.77	106.44	4.7
Ontario	14.38	120.83	135.21	2.4
New Brunswick	14.62	53.21	67.83	9.6
Alberta	7.27	63.48	70.75	1.0
Nova Scotia	6.50	69.25	75.75	3.9
Saskatchewan	8.33	33.06	41.39	1.6
Newfoundland	20.00	83.96	103.96	6.3
Manitoba	9.44	102.22	111.66	1.5
Prince Edward Isle.	-	6.67	6.67	0.2
Yukon and N.W.T.	-	10.00	10.00	-

[a]Source: (Anon., 1984a) ; Value added data for Newfoundland's wood industries derived from (Milne, 1984b, Milne and Mallay, 1984).

In terms of the forestry sector's contribution to provincial GDP, Newfoundland ranks third behind New Brunswick and British Columbia. These statistics provide an indication of the relative importance of forestry to the economies of each province. While the scale of roundwood production and industry output in Newfoundland are small on a national basis, the role of forestry in the provincial economy is far more important in Newfoundland than in many other provinces.

2.8 THE ROLE OF GOVERNMENT IN THE FORESTRY SECTOR

Canada is a Confederation of two territories in the north and ten provinces in the south (see Figure 1, p. 7). The division of legal jurisdiction and political power between the national (federal or Canadian) and regional (provincial) governments is a complex subject. The distribution of powers between the two levels of government originated from the needs of the mid-nineteenth century and was enshrined in the British North America (BNA) Act in 1867. Under Section 109 of the Act, ownership of all Crown lands and natural resources not given over to private hands was granted to each of the provinces (Woodrow, 1980). In the cases of Manitoba, Saskatchewan and Alberta these proprietary rights were retained by the federal government until 1930.

Generally, the federal government maintains jurisdiction over broad national matters such as finance, defense, health and social services, and foreign affiars. In the area of natural resources, the BNA Act provided a fairly narrow limit of jurisdiction. The federal government maintains legislative authority over offshore resources up to the 322 km. limit. Therefore, authority to manage fish and petroleum resources in these waters can be exerted with or without provincial government agreement. On land, the federal government maintains jurisdiction over inland fisheries resources and can legislate some control over all resources on lands reserved for Indians. The federal government is also responsible for navigation and shipping on inland waters and offshore limits. More importantly, the federal government is responsible for trade and commerce and can therefore exercise substantial control over interprovincial and export marketing of resources (Woodrow, 1980). In the north, the federal government maintains political sovereignty over the Yukon and Northwest Territories.

The ten provinces are highly autonomous from the federal government in many ways. Each province has its own elected government with jurisdiction and responsibility for internal finance and economic policy. The provinces maintain independent health, education and social service programs, partially funded by the federal government. In the field of natural resources, the ownership and legal jurisdiction over internal resources is a jealously guarded component of Canada's constitution. These rights impart the authority over the management and sale of natural resources within provincial boundaries. Thus, the provinces can develop their resources in association with provincial economic goals and policies. The provinces also maintain a high degree of authority over municipal planning, intraprovincial transportation and environmental protection.

Conflicts between the two levels of government can and often do occur in the field of natural resources, given the complex and in some cases concurrent jurisdictional authority. Differences in national versus provincial economic policies concerning resource development, pricing, marketing and taxation are common. The issues can sometimes be contentious and in some cases have been the focal point for provincial elections (Mitchell, 1980). This topic is beyond the original scope of the thesis. However, the main note of interest is that primary responsibility over natural resources, including forests, rests with the ten provincial governments.

For Canada as a whole, the provincial governments have jurisdiction to approximately 67 percent of all forest land (Bonnor, 1982). The federal government has jurisdiction to 27 percent in the form of national parks, nature reserves and national defense areas. Private ownership is limited to six percent.

In Newfoundland, the provincial government has jurisdiction to 95 percent of all forest land. Provincial authority over these forests encompasses a wide range of activities. Included are management planning, maintenance of inventory data, forest protection, development of industry operating regulations, assessment of provincial taxes and fees, and general forest policy. The provincial government also assumes a primary role in silvicultural programs on Crown lands. These activities are conducted mainly through the Provincial Forest Service; the Department of Forest Resources and Lands. There are other provincial government departments which play a minor role, for example, in environmental regulation and monitoring, and providing funds for industrial development.

The federal government's main role at present is conducting forest research and funding the bulk of provincial forest management activities. Research is carried out by the Department of Agriculture's Canadian Forestry Service (CFS). The Newfoundland Forestry Centre (NFC) is one of six regional CFS establishments in Canada. The bulk of federal funds to the Newfoundland forestry sector are transferred to the Provincial Department of Forest Resources and Lands through the NFC. Overall, these funds contribute approximately 40 percent to the Provincial forestry budget. Over the past decade, the provincial government has developed a high degree of dependence upon federal funds to conduct its forestry program. Federal funds from other departments are also available to develop wood energy technology, or fund industry modernization for example.

2.9 SUMMARY OF CHAPTER 2

This chapter provides a summary of the major physical, social and economic characteristics of Newfoundland, which lays the groundwork for a detailed analysis of the province's forestry sector. The total land and water area of the province is 405,000 square kilometers, of which 73 percent comprise Labrador, and 27 percent the Island region. The productive forest base of 85,000 km^2 is split between Labrador and the Island on a 65/45 ratio. The annual allowable cut (AAC) on the Island of approximately 3.0 million m^3 provides the main source of fibre for the forest industry in the province. Labrador's resource, which is relatively inaccessible and remote, has limited the development of a significant forest industry in that region. The bulk of forest resources in Newfoundland are owned by the provincial government, especially in Labrador. On the Island, more than one-half of the total productive forest is alienated to industry through a mix of tenures which evolved decades ago.

The forest industry on the Island is dominated by the newsprint sector, consisting of three large mills. Virtually all newsprint produced in Newfoundland is exported outside Canada. There is an active wood industries sector, comprised mainly of small plants manufacturing lumber and miscellaneous wood products for the Newfoundland market. The logging industry is primarily associated with newsprint production. Of the total estimated softwood consumption of 2.4 million m^3 in 1983, the newsprint industry accounted for 65 percent. Domestic fuelwood needs accounted for a further 25 percent. Long-term trends in softwood supply and demand are difficult to analyze due to massive losses due to insects and gaps in provincial AAC projections. While studies in 1980 suggested possible future softwood deficits, no firm conclusions can be drawn at present.

The Newfoundland economy is relatively weak and is constrained by locational disadvantages and few apparent opportunities for growth. The provincial government lacks the capability to exert strong fiscal policy initiatives due to a large load of public debt, a poor revenue base, and taxation levels which are already among the highest in the country. The province relies heavily on federal transfer payments for income and revenue. The disparity in social and economic between Newfoundland and the majority of Canadian regions has continued since the province joined the country through Confederation in 1949.

Given the shallow base of the Newfoundland economy, the contributions of the forestry sector to employment, income and regional development are important. The forest industry, primarily through the newsprint sector, dominates the manufacturing and export base of the province. Overall, the forest industry accounts for more than six percent of total provincial GDP.

The scale and output of the forest industry in Newfoundland rank far below many other provinces in Canada. However, based on value added per m^3 of roundwood production and contribution to provincial GDP, Newfoundland's forest industry ranks quite high. Therefore, the value of the industry to Newfoundland is greater than in many other provinces which may contain a much larger forestry sector.

The provincial and federal governments play a supportive role to industry. In Newfoundland, the majority of forest land is provincially owned and the government maintains primary jurisdiction over most forest management activities. The federal government plays a key role by conducting forest research and funding a high proportion of the provincial government's forestry programs.

3.0 THE PROBLEM OF INADEQUATE SOCIAL VALUATION IN FORESTRY

3.1 BACKGROUND

To gain a better understanding of the term social value, one must first explore the meaning of value itself. A dictionary definition of value includes :

1. the monetary worth of something: marketable price,
2. relative worth, utility or importance,degree of excellence,
3. a numerical quantity assigned or computed,
4. a fair return or equivalent in goods, services, or money for something exchanged,
5. something instrinsically valuable or desirable.

(Webster's Seventh New Collegiate Dictionary, 1963)

The above definition indicates that value has a range of meanings subject to individual interpretation. This conclusion is shared by Sinden and Worrell (1979);

> "Value is not a fixed, inherent property. Rather, it is a variable property whose magnitude depends not only on the nature of the thing itself but also on who evaluates it and the environment in which it is assessed. A thing "i" may have different values for different times, to different people, under different conditions (the physical environment in which the evaluator finds himself), and to different circumstances (the personal, physical, emotional, psychological, social and political situation of the evaluator at the time he makes the valuation)."

Clearly, an object may have a range of values based on the nature of the valuation and the evaluator. This conclusion provides an important backdrop to the following sections which examine the concept of social value and government valuation of forest resources.

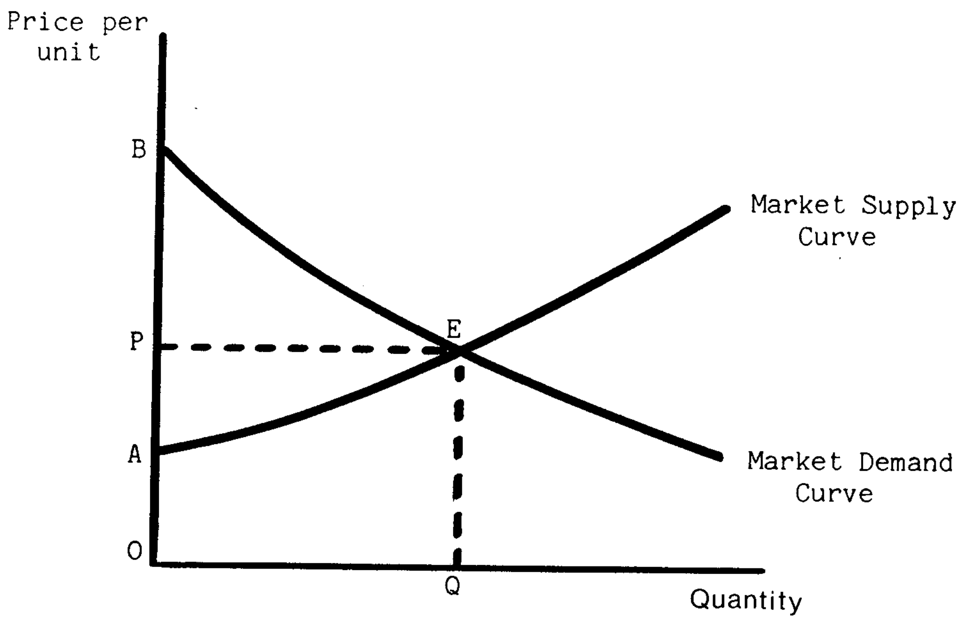
3.2 THE CONCEPT OF SOCIAL VALUE

The concept of social value is concerned with groups of people, and a resource or commodity's ability to satisfy human needs and wants (Ferguson and Maurice, 1978). These groups of people are often referred to as society, or society as a whole. Social value reflects a comparison of utility gained by the group from a resource or commodity, and the disutility involved in realizing any benefits (Sinden and Worrell, 1979). This comparison represents the principle of net social benefits, that is, social benefits minus social costs. Social benefits include all benefits gained by society from a resource or commodity regardless of incidence (Phillips *et al*, 1978). In the case of forest resources, social benefits can include the public benefits of employment and income from timber production, as well as the private returns to industry. Social benefits also include qualities more difficult to measure or extramarket outputs, such as soil stability, provision of wildlife habitat, recreation opportunities and aesthetic views, and the return of oxygen to the environment (Nadeau, 1981).

Social costs on the other hand, can refer to the opportunity costs of a resource or commodity, incident on society (Lipsey *et al*, 1976). Included are both private costs which a firm recognizes in utilizing a resource, and public costs which are not captured by conventional business accounting. In forestry, social costs include private costs of timber production (logging, processing etc.), the extramarket costs of environmental damage and pollution, and government expenditures related to forestry (Carroll and Milne, 1982).

3.3 SOCIAL VALUATION

In theory, an estimate of social value, or net social benefits for a specific resource may be derived from an analysis of market supply and demand information (Figure 7). The area under the demand curve and below the equilibrium price (OPEQ), represents the total revenue or "cash value" of the commodity Q, sold at market price P. The area under the demand curve and above the equilibrium price PEB is the consumer's surplus. This area represents the gain to consumers from paying the actual market price PE, as opposed to their willingness-to-pay a higher price along the demand curve



<u>Key</u>

P	Equilibrium Market Price
Q	Quantity Demanded at Equilibrium
E	Equilibrium Point
OPEQ	Total Revenue
PEB	Consumers Surplus
AEP	Producers Surplus
AEB	Net Social Benefits

Figure 7. Net social benefits

between BE. A producer's surplus is represented by the area AEP. This area indicates the gain to sellers from receiving the market price PE, as opposed to their willingness-to-sell at a lower price along the supply curve between AE. The summation of consumer's surplus and producer's surplus (equivalent to AEB) is a good indication of net social benefits or social value (IMPACT Environomics Ltd., 1976). Alternatively, one can view social benefits as the area OBEQ, and social costs as the area OAEQ. The difference between these two areas is also equal to net social benefits (area AEB). One should note however, that if extramarket costs and benefits are excluded, then only a partial estimate of net social benefits can be derived.

In theory, the measurement of social value is quite straightforward; one simply requires supply and demand schedules for a particular good or commodity, plus associated extramarket costs and benefits. In reality however, one finds the measurement of social value more difficult. Sinden and Worrell (1979) neatly summarize this fact:

> "Social values can only be estimated; they cannot be measured precisely. However, the method a group uses in appraising values is bound to have an effect on the results it gets."

The authors continue by listing three major methods of social valuation in practice, 1) by markets, 2) political processes, and 3) judicial decisions.

1. Market Valuation

As illustrated in Figure 7, under conditions of perfect competition, market equilibrium occurs at a price where the quantities supplied and demanded are equal (Samuelson, 1976). Under these conditions market price reflects a compromise between the valuations of sellers and buyers for a specific good or service. What is the relationship between market price and social value under conditions of perfect competition? According to Mishan (1975), market prices are a poor index of social value. Sinden and Worrell (1979) add that market prices are questionable as indicators of social value and may only provide minimum estimates. There are three main reasons why market price fails to capture full social value;

1. the relative elasticity of the demand and supply curves can influence producer's and consumer's surplus,

2. factors such as income, prices of other related goods, buyer tastes and preferences, and future expectations can affect demand and hence consumer surplus,

3. market price may not recognize external or extramarket costs and benefits.

If market prices under assumptions of perfect competition can only indicate minimum social values, what happens as these assumptions are relaxed? In the real world, market prices are rarely determined under conditions of perfect competition. There are many imperfections in the modern market such as;

- the effect of monopoly and oligopoly structures on market price,
- the influence of taxation and subsidies, regulation of output or price, and direct socialization (Sinden and Worrell, 1979),
- the lack of prices for commodities or services which may be traded (Howe, 1971).

In addition, market prices do not address the concept of income distribution which is important when discussing social value. From a regional accounting stance, total revenue which leaks out of the region through taxes, savings or extraregional expenditures, cannot be considered a regional social benefit. In this case, the commodity or resource may have a high market price but low social value to the region.

In summary, market prices are poor indicators of social value; under assumptions of perfect competition only minimum social values are represented. This situation is exacerbated in the real world where many external factors can influence market price or even the market itself, and produce a range of social values.

2. Political Valuation

Social values reflect the perceptions of groups rather than individuals. In a democratic system of government, politicians represent the views of their constituency which comprise groups of individual voters. Thus, the social valuations of the general public can be transferred to government through politicians.

An alternative view (Porter, 1984) is that the political process may work from the "top down". Government may develop policies which reflect an internal social valuation based upon the perception of politicians and senior bureaucrats, rather than the general public. This approach is often used to place values on resources or commodities that are unsuited to the market process, or are poorly handled by it (Sinden and Worrell, 1979). A government price, reflecting political as opposed to economic criteria, may be established. This conclusion is shared by Dwivedi (1980) who states that while economics will influence policy outcome for resources, politics will decide the allocation of current values.

In summary, the political process can greatly influence prices and the resulting social values for particular resources or commodities. As with market determined factors, political valuation can ultimately produce a range of social values. The application of political valuation to forest resources is developed further in this chapter in sections 3.6 and 3.7.

3. Judicial Valuation

While less common than market or political valuations, the judicial process can be used in determining social values. Invariably, these valuations arise from a legal settlement of a dispute within, or between social groups (Sinden and Worrell, 1979). Also, the goods being valued tend to lack market prices. In the field of natural resources, these goods might include wildlife, air, water and recreation on wilderness land. The judicial system itself is not designed to appraise social values, however in the course of establishing a settlement, social values may be identified. The legal judgement may incorporate social values determined from economic studies, comparisons of values in other regions, and past legal decisions.

An example of judicial social valuation is the case of the Hells Canyon on the border between Oregon and Idaho where a decision to construct a dam for hydro-electric power was challenged by environmentalists. An economic study of the net social benefits from preserving the area for recreation (Krutilla and Cicchetti, 1972) was used in the court's decision which prevented the hydro-electric development from proceeding.

3.4 DISCUSSION

While the three methods of social valuation can operate independently, there is considerable scope for interaction. Certainly, the interplay between market and political valuations can potentially be quite significant. Regardless of how social values are derived, the estimates will not be completely static. Instead, one may view social values in terms of a gradient or spectrum, with the values subject to changes. At one end of the spectrum is the concept of social value defined by net social benefits. In this case, one may assume that all market and non-market costs and benefits can be determined for a specific resource. This point on the spectrum represents a theoretically optimum measure of social value.

Moving down the gradient, a point would be reached where social values are represented by market price under the assumptions of perfect competition. As described earlier, social values would not be fully reflected in this situation.

Travelling further down the gradient one would find social values as represented by market prices in the real world, or determined through political and judicial processes. By continuing down the gradient, the divergence between measured social value and the theoretical optimum of net social benefits will increase. The magnitude of divergence will depend upon the actual method used in valuation, the extent of influencing factors, and the characteristics and objectives of the group making the value estimates. For any specific resource therefore, a range of social value estimates is possible.

3.5 METHODS OF VALUING FOREST RESOURCES

In terms of forest resources, two values are usually mentioned. The first, value-in-use, refers to a forest's ability to satisfy human needs. Values may not depend upon economic scarcity or be determined through exchange (Davis, 1966). From the preceding section, the concept of social value has strong correlations to value-in-use of forest resources. While the literature generally recognizes that forests can produce social benefits, the second and more common forest value concentrates on market economics and stumpage (Davis, 1966; Gregory, 1972; Sinden and Worrell, 1979).

Stumpage is the price paid to the owner of forest resources by an individual or group, for the right to cut standing timber (Haley, 1980). In a perfectly competitive market, the exchange price represents a compromise between the timber owner's and prospective buyer's perception of the forest's value for specific outputs. From the land owner's point of view, stumpage represents an economic return, or revenue from the sale of standing timber. On the other hand, the buyer regards stumpage as a cost. The amount a buyer can afford to pay towards stumpage is calculated from the value of recoverable products such as lumber or pulp, less all costs of harvesting and processing, including an allowance for profit and risk. Therefore, stumpage represents a residual value, often referred to as an economic surplus (Barlow, 1972).

There are many factors which can influence the stumpage value in competitive markets. On the product value side, differences in timber volume, tree size and wood quality will determine which outputs can be manufactured from a given stand. The selling value is quite different for example, between lumber, pulp, and veneer logs. On the cost side, harvesting costs are influenced by stand density, tree size, topography, road requirements and operating season. Transport costs are primarily affected by the distance to the processing mill, although road standards, topography and operating season are also important factors. Processing costs are influenced by species type, log size and general mill efficiency.

The interplay between the various cost and revenue factors will determine the magnitude of the stumpage value for any timber stand under competitive markets. Where a large economic surplus exists, the stand will have a high stumpage value and is deemed an intramarginal resource. Where product revenues just equal costs, including profit and risk, no economic surplus exists. In this case, the stumpage value will be zero and the resource is said to be marginal. Where costs exceed revenues, the resource is submarginal and subsidies may be required by prospective users to encourage utilization.

These examples illustrate that under perfect market conditions, the stumpage value, or market price of forest resources can be quite variable. As discussed earlier, market prices under perfect competitive conditions are poor indicators of social value. In the real world, market prices for timber can be affected by market structure, forest ownership, taxation and expectations of future prices by timber owners and buyers (Gregory, 1972). The main failure of stumpage to reflect social value however, stems from the fact that only timber product values are represented. The social benefits of employment and income generated by timber production for example, are not fully included in stumpage. Social costs of erosion and pollution are also not recognized through a stumpage price. While stumpage prices may reflect some measure of a forest resource's social value, many elements of social cost and benefit are ignored.

3.6 FOREST RESOURCE VALUATION IN CANADA

From chapter 2, the provincial governments were seen to own the bulk of productive forest land in Canada and maintain legal jurisdiction over forest resource management. The provincial governments generally value their forest resources by two methods; 1) legislated rates, and 2) appraised values.

1. Legislated Rates

The most common method of valuing productive forests is through the use of legislated rates. Each of Canada's ten provinces use this approach to some degree, whereby timber consumers pay the goverment an arbitrary stumpage rate per m^3 of fibre harvested. These rates may be fixed for any length of time or can be subject to periodic review and revision. In some instances stumpage rates are indexed to changes in product value or some component of cost (Canadian Pulp and Paper Association, 1982). There may also be regional rate differences within a province to reflect smaller tree volumes in northern areas and its influence on economic surplus. In addition, alternative rates may be assigned to different tree species, or between healthy and damaged trees to reflect variable product values.

The main advantages of legislated rates are their simplicity and inexpensive administration (Anon., 1980). Stumpage rates are first determined by government and then simply established throughout the province. The major disadvantage is the lack of flexibility. Legislated stumpage rates are relatively independent from specific site conditions, stand characteristics and location which can greatly influence production costs, product values and the potential economic surplus. The practices of setting regional stumpage rates or alternative rates by species, are attempts at reducing this inflexibility. However, the more complicated the system becomes, the more expensive is its administration. The lack of flexibility means that stumpage rates will not reflect the full economic surplus for specific forest stands as would occur under prices set through competitive markets. Legislated rates represent a political valuation of forest resources with only limited input by market factors.

2. Appraised Values

Appraisal systems to value timber from productive forests are used mainly in British Columbia, and to a lesser extent in Alberta (Canadian Pulp and Paper Association, 1982). Unlike legislated stumpage rates, an appraisal system attempts to estimate the economic surplus of specific forest stands based on a comparison of expected product revenues and production costs. These revenue and cost factors are derived from industry-wide surveys within the province and are blended to represent an operator of average efficiency (Anon., 1980). The factors may be revised periodically, or indexed to price/cost changes on a monthly, quarterly, or annual basis.

The main advantage of an appraisal system is its flexibility. The average cost and revenue factors are used as a base to which modifications are made during the actual field appraisal of a specific forest stand. Tree species, stand volume, wood quality, topography, distance to the mill, and final product type are some of the criteria used to modify the average appraisal base values.

Theoretically, the appraised stumpage value should equal the full economic surplus from any forest stand. In practice however, this equality may not occur. One disadvantage of appraisals is the subjectivity involved whereby the Provincial forestry officer modifies the average cost and revenue factors for each stand. A second disadvantage is the complexity and high administrative cost of appraising each forest stand to be harvested. In British Columbia the appraisal system cost an estimated $21 million in 1979, or nearly 10 percent of all stumpage revenue collected (Anon.,1980). Although appraised stumpage values more fully reflect a forest's economic surplus than through legislated rates, the system has its own disadvantages.

3.7 DISCUSSION

Pricing forest resources through a competitive market approach is uncommon in Canada. Instead, the provincial governments as resource owners, favour a system of legislated stumpage rates or appraisals. These methods may not value timber at its full economic surplus as might occur under prices established through competitive markets. When one recalls that social values are poorly represented by competitive market prices, the Canadian approach to pricing forests may lie even further down the social value gradient. Therefore, the divergence between social values measured by stumpage price and those represented through the concept of net social benefits may be quite large. At this point in the discussion, two questions arise; 1) are Canadian stumpage values lower than in other countries with similar resources, and 2) why are competitive stumpage markets so rare in Canada?

In 1981, the unweighted average provincial government stumpage rate across Canada was approximately \$2.00 per m^3 for softwood pulplogs (Canadian Pulp and Paper Association, 1982). In comparison, the average stumpage rate for softwood pulplogs in Finland under competitive markets was \$14.00 per m^3 (Anon., 1983c). Haley (1980) showed that in 1978, stumpage prices for softwoods in the northwest United States were more than eight times higher than in British Columbia. These comparisons indicate that provincial governments in Canada may be undervaluing their forest resources. This conclusion must however, be viewed with caution. Comparisons of stumpage values between countries are difficult due to variations in tax systems, operating costs, and tenure arrangements. In addition, the influence of speculative bidding upon timber prices in a market system can be substantial (Smith, 1981). Also, there is no conclusive evidence that the industry is reaping a windfall benefit of the timber's economic surplus at government's expense. The lack of published data on industry cost structures constrains an objective analysis of resource rents in forestry. If the industry is operating at the extensive margin of production as is often claimed, then current stumpage rates may indeed be a fair reflection of the economic surplus. By international standards however, Canadian stumpage prices are low.

If one takes the view that Canadian stumpage prices are low, what is the rationale for current pricing methods and timber prices? The answer to this question lies in a combination of historic trends, provincial government economic development policies, and existing tenure arrangements with industry. During the 1800's, forests were exploited as settlement gradually pushed westward across the nation (Reed, 1980). Forests were initially utilized as a source of building materials, fuelwood and naval timber. Also, the need for agricultural land in southern areas necessitated removal of many forest stands. Forests generated the capital required to build a growing forest industry, and provide social benefits of employment, income and public revenues in a developing country. By the early 1900's, the forestry sector had evolved into a major industry with exports of lumber and paper products to the United States (Reed, 1980).

To encourage economic development in more remote interior and northern forests, provincial governments offered a variety of incentives such as low stumpage fees, long term-leases (Haley, 1971) and in some cases, actual land ownership (Munro, 1978). By the early 1970's, most of Canada's economically accessible and productive forests had been allocated to industry through several forms of tenure arrangements (Armson, 1977). At present, two general tenure types have evolved (Ainscough, 1977; Bird, 1980; Carroll, 1977; Dancik *et al.*, 1979; Nautiyal, 1977; Pearse, 1976; Poole *et al.*, 1981b; Smith, 1977; Wetton, 1977).

The first tenure type is a renewable lease for a specific forest area and corresponding timber volume, for periods ranging from 10 to 21 years. These tenures are common between the provincial government and a single company with one or more large processing plants such as a newsprint mill. The leases are renewed by the government upon expiry if the terms and conditions have been adhered to by the company in the preceding lease period. The company benefits by securing a long-term wood supply, free from market competition and speculative bidding. This assurance is usually required before a firm will invest the huge sums of capital needed to construct a large mill. The company's long-term financial planning will also benefit from relatively stable stumpage prices. The provincial government benefits by securing long-term economic activity in conjunction with internal regional development policies. Collection of the full economic surplus from forest resources is a secondary goal to that of creating employment and income opportunities in less developed regions. Therefore, broader social and economic goals are important criteria in a government's strategy for allocating timber through long-term leases and low stumpage prices.

The second tenure approach commonly used is directed to smaller firms or even individuals through the issuance of a timber licence. These licences have periods ranging up to 10 years and provide the holder with cutting rights to a specific timber volume in a given region. Timber licences are also used by provincial governments to stimulate economic development, although on a smaller scale than with the longer-term leases. Timber licences may be issued to owners of large sawmills for example. Generally, the greater the mill investment, the longer is the term of the licence.

The preceding discussion provides a simplified view of tenure arrangements and timber valuation in Canada. In reality, every province has slight differences with tenure arrangements, stumpage rates and forest policies. For example, large companies in Alberta operating under 20 year renewable leases are responsible for nearly all forest management costs. As a comparison, large firms in Ontario and British Columbia share these costs with the government. For all provinces however, there are three common points;

1. current tenure structures and pricing approaches in forestry have evolved from historic patterns in the development of remote interior and northern lands,

2. provincial governments have pursued a policy of charging low resource rents via stumpage prices to achieve regional development goals,

3. provincial governments continue to accept low stumpage prices in return for maintaining forest industry stability and hence, economic activity in less developed regions.

Clearly, the current tenure and timber pricing policies indicate that provincial governments recognize the social value of forestry development. However, this value is not reflected explicitly through stumpage prices for the forest resource itself. Canadian stumpage prices appear to be lower than might be the case under more competitive market conditions. Therefore, current stumpage prices do not adequately represent the social value of the resource. One should note however, that even under the theoretical conditions of perfect competition, market prices are poor indicators of social value. In this context, arguments for raising Canadian stumpage rates may be misguided. Also, given the current tenure and pricing policies of provincial governments, introducing the idea of competitive timber markets would be difficult. The problem of stumpage prices undervaluing the social worth of the forest resource still remains however. The implications of this problem are discussed in the next section which examines in detail the pricing of timber in Newfoundland.

3.8 FOREST RESOURCE VALUATION IN NEWFOUNDLAND

3.8.1 Background

The evolution of forest land tenure and timber valuation in Newfoundland generally follows the pattern which occurred in other regions of Canada. The current situation of tenure and pricing in Newfoundland reflects a history of government policies designed to promote regional development through the forestry sector (Munro, 1978). One can facilitate an examination of tenure evolution and timber pricing structures by classifying forest land into two broad categories. These are; alienated lands and, unalienated Crown lands. The following sections briefly summarize the evolution of different tenure types within each of these two broad categories. A more detailed analysis is provided in Munro's study.

3.8.2 Alienated Lands

The term alienated land is commonly used in Newfoundland to describe forest land within the province that is held under some form of tenure by private industry. Alienated land in the context of forestry incorporates three types of tenure; freehold grants, timber leases and timber licences.

1. Freehold Grants

Beginning in the 1800's the government of Newfoundland was gradually becoming aware of the need to diversify the Island's economy. At that time, fishing was the major source of employment to a population concentrated along the coast. The government desired to develop the Island's interior region and introduce new industries into the economy. The interior lands were viewed as a rich source of timber and minerals which could be used as an inducement for private industrial development. By the late 1800's, construction of a trans-Island railway was started by the Reid Newfoundland Company as the first step in opening up interior lands. The railway was completed in 1897 and as payment, the government granted the Reid family fee simple (or freehold) ownership to 10,352 km^2 of interior land. The rights conveyed by the government included ownership of all resources such as timber, minerals and water in perpetuity. As well, the Reid family could transfer full or partial ownership rights by direct sale to others. Public access to freehold lands was not protected.

2. Timber Leases

Only one timber lease has been issued by the government of Newfoundland. In 1905, the government granted the Anglo-Newfoundland Development Company (A.N.D.Co) lease ownership to 5180 km^2 of land to encourage construction of a newsprint mill. The lease was for 99 years, renewable under the same terms and conditions at the lessee's discretion. The lease conveyed to the company, rights to all timber, water and mineral resources. Public access for recreational fishing and hunting was preserved. The terms of the lease were a sufficient inducement for the A.N.D.Co. to construct a newsprint mill in Grand Falls. This mill is currently owned by Abitibi-Price Inc. and is still in production.

3. Timber Licences

Timber licences were used by the government between 1887 and 1944 to also encourage economic development of interior lands. Like the A.N.D.Co. timber lease, timber licences conveyed full rights to all resources on, or under the land. However, timber licences were renewable upon expiry at the discretion of the government, not the licencee. Public access to licenced areas was protected. While licence periods ranged from 21 to 99 years, the bulk of the licences were for 99 year terms and were issued between 1900 and 1912. During this time period, most interior forests not already alienated through freehold or lease ownership, were allocated using long term licences. By 1944, the total licenced area was approximately 52,000 km^2. Timber licences were a marketable commodity, therefore ownership could, and often did change hands.

3.8.3 Consolidation of Alienated Lands

The present pattern of alienated forest land in the Island's interior region reflects a consolidation of freehold, leased and licenced areas between private interests. This consolidation began in the early 1900's in association with the issuance of numerous timber licences. Many of the licences issued by the government did not result in successful development of a wood processing plant. Where mills failed, the timber licences were often sold to other companies wishing to expand their own land holdings. In other cases, licences were held by speculators who had no intention of constructing a processing plant. The other means of expanding timber limits was through the purchase of freehold land from the Reid interests. The owners of the Grand Falls newsprint mill acquired additional timber land to its lease area by purchasing 1600 km^2 of freehold land from other individuals or firms. The newsprint mill at Corner Brook acquired all of its timber land through purchases. The mill owners gradually bought 6070 km^2 of freehold, and nearly 25,000 km^2 of licenced land.

The charges associated with alienated timber limits are similar for lease and licenced areas. A ground rent of \$0.77 per km^2 is assessed each year and the agreements stipulate a stumpage rate of \$0.50 per thousand board feet (MFBM) for any lumber produced. No stumpage is charged for pulpwood production. Therefore, given that the Grand Falls and Corner Brook mills have produced only pulp or newsprint, the government has never collected stumpage from their lease and licenced areas. At present however, the two companies pay a property tax, assessed on freehold, lease and licenced land. The tax resulted from the Forest Land (Management and Taxation) Act, 1974. The Act's four major objectives were to :

1. encourage forest management on timber limits held by the two paper companies,
2. encourage the companies to relinquish lands held in excess of requirements,
3. generate revenue to finance fire protection,
4. place all provincial forest land under sustained yield management. (Gray, 1981).

The first three objectives are pursued through a differential property tax. A lower tax is assessed on limits for which an approved management plan has been submitted by the company. On lands deemed unmanaged by the lack of such a plan, a higher tax is imposed. There is also a minimum tax level which can be applied. The Act has been highly successful in achieving its objectives. Management plans are now prepared for all forest areas in the province and efforts are continuing to develop a regulated forest under sustained yield. The paper companies prepare management plans for their own limits, therefore these areas are deemed to be managed and are assessed the minimum property tax, which in 1981 was $0.23 per hectare. The companies in some cases have relinquished marginal and sub-marginal lands. As an example, the Corner Brook mill returned 534,000 hectares of land to the government after 1974. Tax revenues collected by the provincial government are approximately $1,000,000 annually.

There are no revenues paid to the province from resource use on freehold land except the property tax. When the government conveyed this land to the Reid interests, it relinquished rights to collect rents from the natural resources. Thus, no stumpage or ground rent is paid by current owners of freehold land.

3.8.4 Unalienated Crown Lands

In the context of forestry, unalienated Crown lands refer to land which is owned by the province and is not allocated to industry under freehold, lease or licence tenures. These unalienated lands are generally located along the coast of the Island and also comprise most of Labrador. On the Island, coastal forests have traditionally been used by fishermen and their families as a source of building materials, drying flakes and fuelwood. The principle of reserving coastal forests for domestic use was recognized by government in the early 1900's. Policies which discouraged allocation of commercial timber leases and licences within three miles of tidewater were generally adhered to although no statutory requirements existed. These policies were formally recognized by government in the 1930 Crown Lands Act which reserved forests in the three mile limit for domestic use.

The 1974 Forest Land (Management and Taxation) Act consolidated land in the three mile limit with other non-alienated Crown lands. The Act improved the level of management on all unalienated Crown lands by requiring cutting permits and establishing more controls over timber extraction. The province also undertook responsibility for preparing management plans on these lands.

In Labrador, a total of 76,000 km^2 of timber licences were issued by the government to encourage economic development. Virtually all licences however, failed to secure significant industrial activity from either large sawmills, or pulp and paper plants. These licences therefore, reverted back to the Crown. At present, the majority of land in Labrador is provincially owned unalienated Crown land.

Stumpage charges for timber from unalienated Crown lands have existed since the early 1900's. For example, the Sawmills Act (Amended 1915) required that commercial sawmillers in the three mile limit pay a fee of $5.00, plus a royalty of $1.00 per 1,000 board feet of lumber. At present there are two main permits for cutting timber from unalienated Crown lands. A Domestic Permit allows an individual to cut up to 30 m^3 of timber for domestic use. The permit costs $2.00 and no stumpage is charged. A Commercial Permit allows the holder to harvest up to 30,000 m^3 of timber for commercial use such as pulpwood, sawlog or fuelwood sales. The permit costs $2.00, however, stumpage is charged using a system of legislated rates (Table 17). The stumpage rates are linked to price indices for lumber and newsprint, and a cost index related to government purchases of goods and services. Holders of Domestic or Commercial Permits are not subject to ground rent or property taxes since the permits provide cutting rights to a volume of timber only.

TABLE 17

Stumpage rates, unalienated crown lands, Newfoundland, 1983/84[a]

Timber Type	Stumpage Rate	
	No Existing Government Road	With Existing Government Road
1. Sawlogs		
Hardwood-Softwood	$ 5.15/MFBM	$ 7.20/MFBM
Pine	10.30/MFBM	12.40/MFBM
2. Construction Timber	$4.50/m^3$	$4.50/m^3$
3. Commercial Timber	$0.70/m^3$	$0.70/m^3$
4. Christmas Trees	0.10/tree	0.10/tree
5. Pulpwood		
Healthy - Bark on	$1.20/m^3$	$2.40/m^3$
Healthy - Peeled	$1.35/m^3$	$2.70/m^3$
Damaged - Bark on	$0.75/m^3$	$1.20/m^3$
Damaged - Peeled	$0.90/m^3$	$1.35/m^3$

Note: On areas with timber volumes less than 60 m^3/ha, stumpage fees will be reduced by \$0.30/m^3.

[a]Source:(Anon. 1983b)

3.9 DISCUSSION

The evolution of tenure structures and forest resource valuation in Newfoundland has many parallels with the general Canadian pattern. The development of interior forest lands was linked with the Newfoundland government's goal of diversifying the economy and opening up more remote areas of the province. This goal was achieved through policies which provided freehold land and long-term lease or licence tenures to industry. The current tenure structure on interior forests reflects these policies. There also appears to have been an implicit government policy of accepting low or even zero resource rents from these tenures in return for capturing social benefits such as rural employment and income. The paper mills at Grand Falls and Corner Brook pay no stumpage on pulpwood harvested from their limits. The lack of any explicit value represents an extreme form of political valuation. On the social value continuum, this situation represents a wide divergence from the optimum concept of net social benefits.

One may argue that the property tax assessed on these limits is an alternative method to putting some type of explicit value on the wood resources. However, this argument does not mesh with the specific objectives of the Forest Land (Management and Taxation) Act 1974. The tax was not designed as a de facto stumpage charge, but rather to address broader forest management issues. Also, the minimum tax charged at present is assessed on the total land holdings of the two established paper companies. The tax is not based on the land's gross timber volume or on the volume harvested.

On unalienated Crown lands, forest resources are valued by the provincial government through a system of legislated stumpage rates. Stumpage is paid by small commercial operators and a third more recent newsprint mill which was allocated a 20-year renewable tenure. While the stumpage rates are comparable to the Canadian average, they share the similar problem of inadequately reflecting the resource's social value.

Domestic wood consumers in Newfoundland do not pay stumpage. The provincial government has continued a long standing policy of preserving the traditional rights of Newfoundlanders to harvest wood for domestic use. The low permit price of $2.00 and absence of stumpage charges provides virtually free access to unalienated Crown forests. In many ways, these forests resemble a common property resource (Milne, 1982). On these forests, social values are poorly represented.

3.10 THE PROBLEM OF INADEQUATE SOCIAL VALUATION

The preceding sections have illustrated that provincial governments price their forest resources through a system of appraised values, or more commonly, legislated rates. Current tenure and pricing structures reflect policies of economic development taking precedence over capturing resource rents. Political valuation appears to be the main criterion in pricing forest resources. Newfoundland represents an extreme example with domestic cutters and two of the Island's three newsprint mills not paying any stumpage. The provincial government has implicitly traded low or zero stumpage in return for social benefits created by an active forest industry. These benefits include employment, income and value added (Carroll, 1977). From a government or public perspective, these benefits can be substantial. As shown in chapter 2, the Newfoundland forest industry is of vital importance to the provincial economy.

The social benefits generated by the Newfoundland forest industry result from the harvesting and processing of mainly provincially owned forest resources. Therefore, the forest resources are the primary determinant of social benefits produced. Intuitively these resources must have a high social value from a government perspective. The central root of the problem is that the provincial government values its forest resources based on stumpage prices only. Clearly, stumpage prices in Newfoundland undervalue the forest resource in terms of social benefits created. Of concern, is the fact that the government bases policy decisions relating to the forest resource on stumpage values, rather than some improved measure of social value.

There are many instances where the government's use of inadequate forest resource values can influence internal policy decisions. One example is the problem of land-use conflicts between forestry and other competing uses such as agriculture. Basing the value of forests solely on stumpage prices may bias arguments in favour of the alternate use.

Another example is the problem of evaluating silviculture investments in an intensive management program. In Newfoundland, using stumpage prices as the sole forestry benefit at rotation age can indicate that reforestation is not economic in terms of net present value (Milne, 1981a). A government decision not to reforest cutovers could have far-reaching economic implications in the future.

Further examples include policies regarding forest protection, or government funding to the forest industry. In all these cases, an economic analysis of various policy options is handicapped by inadequate forest resource values. More importantly, the government may ultimately choose policies which hinder the growth and development of the forestry sector.

To address this problem, a better measure of the forest resource's social value is required. The solution does not lie with changing stumpage rates. Instead, an internal government value is needed since the provincial government has jurisdiction over its forest resources and determines the direction of forest policy. This internal value should recognize as many social costs and benefits as possible. Therefore, the objective is to move up the social value gradient towards the concept of net social benefits.

3.11 SUMMARY OF CHAPTER 3

In this chapter the theory of value and social value was briefly examined. Social values are not fixed, but instead lie on a gradient. The actual measurement of social value by either market, political or judicial processes will determine where on the gradient it falls. There are many factors which influence the divergence between the social values measured, and the optimum represented by net social benefits where all costs and benefits are included. The value of forest resources is commonly measured through market prices which do not adequately reflect social values. The value of forest resources in Canada is generally determined through a political process. Provincial governments have purposely followed a policy of charging low prices for their forest resources, in return for the social benefits of economic development. The situation of industry tenure and resource pricing in Newfoundland represents an extreme example of political valuation of forest resources. The divergence between stumpage price and the actual social value of the forest resource is a problem in Newfoundland. The lack of an internal value which better reflects the social benefits of forest resources can seriously hamper effective economic analyses and policy decisions by government. An improved measure of a forest's social value is required incorporating the concept of net social benefits.

4.0 DEVELOPING A MODEL TO ESTIMATE THE SOCIAL VALUE OF FOREST RESOURCES

4.1 ECONOMIC BACKGROUND

In the previous chapter, a need for governments to develop a better measure of value for timber resources was identified. Such a measure should theoretically reflect to some degree, the concept of net social benefits resulting from the harvesting and processing of forest resources. This measure would be used primarily as an internal government value for economic analyses and policy decisions.

The preceding description suggests that parallels with benefit cost analysis may exist, however there are two fundamental differences. First, a benefit-cost analysis is normally used to determine the net social benefits of new developments. In this regard, the analysis can address questions of selecting the best project from among several alternatives, or determining the optimum output level for one project (Mishan, 1975). Examples in Canada include benefit-cost studies of new hydro-electric dams, offshore oil production, and shipping terminals. For specific examples of applications in the natural resource field, the reader may refer to Howe (1971) who evaluates water resource developments, and FAO (1979) which uses benefit-cost analysis to determine the feasibility of forestry projects in third-world countries. In this present study, a major divergence from the usual benefit-cost approach is the evaluation of net benefits from ongoing forestry activity rather than for a new project. The main focus is on the flow of productive services resulting from the harvesting and processing of forest resources.

The second major difference lies in the scope of the analysis. Normally, one might evaluate the net benefits from all forest resources in a particular region such as one province. Thus, the net benefits arising from parks and wilderness areas in the region for example, would be included in addition to the net benefits from timber production. In this study however, the primary goal is to evaluate the net benefits from the use of commercial forests in terms of timber production alone.

Further points to discuss are the concept of accounting stance and the analytical approach. In this study two accounting stances will be used a) provincial and b) federal or national. Since both levels of government incur costs and receive benefits from the forestry sector, any valuation model must incorporate a provincial as well as a broader national view. The main emphasis however will be at the provincial level because of the jurisdictional control of most forest stocks by each province. Also, while the aggregate forestry sector in Canada is important to the national economy, the contribution from any single province is small. The net benefits from forestry are proportionally more important at the provincial level.

The analytical approach relates to questions about the nature of any model of the forestry sector; should the analysis reflect the concept of net benefits to society, or concentrate on net benefits to government? Theoretically, by adding the word "social" to a benefit-cost analysis, one must view benefits and costs incident on society as a whole, within the boundaries defined by the chosen accounting stance. Thus, benefits and costs incident upon both public and private interests are aggregated and evaluated (Sewell *et al*, 1965). Alternatively, one may wish to isolate the two groups comprising society and restrict the analysis to only one group. In this case, the analysis does not provide estimates of full net social benefits but rather net benefits or value to a specific sector of society. In theory, these alternative aproaches yield quite different results. In reality, the situation is less clear. For example, over the past decade in Canada, the importance of the forestry sector to provincial and national economies has been stressed in numerous speeches, policy papers and publications.[1] The major contributions usually include employment, income, government revenues, foreign exchange earnings and community stability. The general public's perception of these contributions is that they are benefits to society, both at the provincial and national level. While some of these economic contributions are benefits to society as a whole, others such as tax revenues are simply income transfers and have no place in a social benefit-cost analysis. The economic contributions are also perceived as being benefits to government. Certainly, tax revenues benefit provincial and

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[1] See for example (Anon., 1981a; Milne, 1984b; Nadeau, 1981; Reed, 1979.)

national treasuries, and forestry-derived economic activity reduces social security payments in regions where labour would be otherwise unemployed. There appears to be some confusion over the use of terms such as social, public and government benefits from forestry.

A second point to consider under the analytical approach is the inclusion of cost variables, regardless of whether one is viewing the forestry sector's contribution from a government or social perspective. The concept of **net** benefits from forestry resource consumption is rarely discussed and represents a major weakness in current Canadian literature. Some measure of cost should be included.

The primary objective of this chapter is to develop a framework for deriving a better measure of value of forest resources in Canada. Both provincial and national accounting stances should be used. A strategy to address the confusion over social versus public or government value is to develop a series of models. Initially, one may develop a simple model from the narrow perspective of the government only, under each accounting stance. In this approach, various measures of financial benefits and costs incident on government would be compared to provide a value representing net benefits from commercial forest resource consumption.

A more advanced model would attempt to estimate a broader measure of net value by including major social benefits and costs arising from forestry production. This approach would undoubtedly require more detailed data but would also yield better results from a theoretical view.

Any models developed should provide for flexibility in choosing which benefit and cost variables to include. The choice of variables in theory may be wide ranging. In reality however, the selection of specific variables will be heavily influenced by the availability of data. As well, the complexity of any model usually increases as the number of variables increases.

Two additional concepts which warrant a brief discussion are discounting and income distribution. Discounting is a procedure used to compare intertemporal costs and benefits. In simple terms, discounting places a value on time and is essential in benefit-cost studies.[2] The models to be developed in this chapter may not require the use of discounting if one is concentrating on net benefits or net social benefits at a specific time from current forest resource consumption. A detailed discussion of discounting is provided in chapter 7. The second concept, income distribution or equity, is concerned with the distribution of benefits and costs from a particular project. Normally, social benefit-cost studies do not address distributional effects. These must be considered in a separate study using an alternative approach such as impact analysis.[3] This question will be addressed in chapter 7 which will apply model results to current problems in forest policy.

4.2 FOREST RESOURCE BACKGROUND

If one is valuing the forest resource based on the benefits and costs resulting from industrial activity, there are two alternative approaches. The first is based on the total forest growing stock of a province which is suitable for commercial consumption. These forests are deemed productive and are judged to yield a commercial forest stand at maturity. The magnitude of the growing stock determines the level of timber available for current consumption. In Canada, all provinces pursue with some degree of success, a policy of sustained-yield management or even-flow of timber volumes. Quite simply, average forest resource consumption is normally not allowed to exceed the annual forest increment over a given time period. Using various analytical methods, the annual allowable cut (AAC) is calculated, based on the volume of productive forest available.[4] Thus, under a policy of sustained-yield management and factors such as utilization requirements and merchantability standards, the forest growing stock will yield a maximum allowable volume for industrial consumption with subsequent generation of economic benefits.

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[2]The reader may refer to (Mumey, 1977; Cissell and Cissell, 1972; Davis, 1966; Gregory, 1972) for the theory and application of discounting.

[3]A thorough discussion of distribution theory and analytical approaches to address this question are found in (Gillen *et al*, 1979; Phillips *et al*, 1979; Samuelson, 1976.)

[4]A thorough discussion of methods for calculating AAC can be found in (Davis, 1966).

The AAC can and does fluctuate over time. Two factors which affect AAC have already been mentioned; utilization requirements and merchantability standards. The former refers to government regulations which require timber users to harvest trees down to a particular size. Diameter limits at the top and base are usually prescribed and vary with specific products. For example, sawlogs will have larger diameter limits than pulpwood. With respect to AAC, reducing the diameter limit will increase the volume of wood to be removed from a stand, and hence expand the AAC. Regulations to encourage use of branches or even stumps will also have the effect of expanding current inventory and thus the AAC.

Merchantability standards refer to the minimum average stand volumes which are deemed to be commercial at maturity. By reducing merchantability standards, a greater area of forest will be considered commercial. Hence, the AAC will rise.

Factors which reduce the forest growing stock such as insects, fire and disease, flooding and windthrow, will act to reduce the available inventory. Obviously, under a sustained-yield management policy, reductions in the total growing stock will consequently mean a smaller annual increment and AAC.

A factor which can also influence AAC is the level of regeneration of harvested forest areas. Forests are renewable and will usually regenerate themselves to a certain extent, given sufficient time (Lyon and Sedjo, 1983). While the forest may regenerate, the level of stocking and species composition may be such that the new stand is uneconomic to harvest at maturity. This problem points out the need for some level of investment by man in reforestation and stand tending. Failure to do so might ultimately result in a smaller growing stock in the future with a reduced AAC. There are a wide range of investment options available to forest owners. First, the level of investment in new forest capital may simply maintain the long term AAC at its current level. Second, investments may greatly increase the future growing stock and hence the AAC. If there is a high proportion of mature and overmature stands in the current age class structure, increased future AAC from current intensive management can be harvested over the present rotation. This relationship is known as the allowable cut effect. Teeguarden (1973) provides an excellent definition;

> "The prospective increase in future inventory due to an increase in inputs(e.g., more intensive management practices) will be harvested in equal annual amounts beginning now and extending over a period equal to one rotation."

If no surplus of old-growth timber exists, the increased AAC from intensive management may be available only at the end of the current rotation. Further discussion on the allowable cut effect is available in the literature, see for example (Schweitzer *et al*, 1972; Beuter and Handy, 1974; Carroll, 1978).

One may conclude that the AAC is flexible rather than fixed, over a rotation period even under a sustained-yield management policy. Forests are a dynamic resource, subject to accruals and depletion from many factors. The volume of the growing stock and hence AAC can be modified over time. Thus, the level of potential maximum resource consumption and associated economic benefits are also subject to change.

The second approach to valuing the forest resource can be based on the level of current consumption as opposed to AAC which represents the maximum harvest under sustained yield constraints. The linkage between current resource consumption (harvesting and processing) and the resulting economic and social benefits should be intuitively clear. With a given industrial structure, an increase in output and hence wood consumption will lead to an increase in economic activity. In these cases, one is referring to short-term changes in output with a relatively fixed industry capacity. The change in economic and social benefits arises primarily from changes in income levels. As an example, an increase in output will generate higher industry income through sales revenue both for the harvesting and processing sectors. Industrial expenditure on other inputs such as fuel and electricity, materials and supplies used in production will also increase. A proportion of these expenditures will be made within the local community, others outside the community yet within the province, and the remainder outside the province. With a fixed labour force, employee wages and salaries will also increase as workers engage in extra shifts or overtime to produce the increased output. Alternatively, if additional employees are added to the labour force, total employee income levels will also increase. A proportion of this increased income will be spent after deducting tax and savings leakages. Expenditure within the region of interest can be defined as an injection of income. At the provincial level therefore, a general increase in income levels and economic activity will occur through industry and employee expenditures. As this income is circulated throughout the region, indirect income levels will also increase through the multiplier effect in the short-run (Tiebout, 1962). One should realize that this multiplier effect varies with the structure and scale of the regional economy. A province with a weakly developed economic base such as Newfoundland will import many of the goods and services required by forest industry firms and employees. Therefore, the leakage of income from expenditure may be quite substantial resulting in a multiplier effect that is smaller than might occur in a more developed economy.

Using a narrower perspective of government income benefits, the flow of revenues from industry will also fluctuate with changes in industry output. These revenues include various direct and indirect taxes plus stumpage fees. Public revenues generated by the forest industry in Canada are sensitive to production levels, a conclusion shared by several authors, see (White, 1982; Milne, 1981b; Howard, 1978) for example.

The preceding discussions are concerned with short-term changes in income flow due to fluctuating output in the forestry sector. The exogenous factor influencing output levels is market demand for the various products from the forestry sector such as logs, chips, lumber, and paper. The forest industry in Canada has historically exhibited short-term fluctuations in output while undergoing long-term increases in capacity and production (Aird and Ottens, 1979). The short-term fluctuations in output were most evident in lumber while pulp and paper products were more stable (Anon., 1984a).

The main focus of this second approach to valuing forest resources is on current consumption and the resulting social and economic benefits. This study does not address the topic of long-term industry growth and increases in output through capital deepening and technological change. The reader may refer to Manning and Thornburn (1971) which examines this subject in the context of the Canadian pulp and paper industry.

With either resource valuation approach, (based on AAC or current consumption), there are two options for measurement. The first is based simply on volume measurement which in Canada is cubic metres.. Therefore, if the consumption of (x) m^3 of commercial forest in a specific time period generates (y) net benefits, then the value per m^3 of the resource used is simply (y divided by x). Assuming the level of net benefits increases with output and resource consumption, one can estimate (y) based on the AAC, using empirical trends between roundwood use and net benefits. In this approach, one can develop estimates of the value of one m^3 of wood based on current consumption, and the potential value based on the AAC.

The second option is to value the resource on an area basis which in Canada is hectares. The linkage between timber volume and forest area must be emphasized. Both current consumption and the AAC on a volume basis will relate to a corresponding area of productive forest. The conversion from volume to area is relatively simple using forest inventory data.

The objective in developing both volume and area value estimates lies in their different applications towards policy problems. Volume-based resource values are useful in policy decisions relating to investment in intensive management. Area-based resource values are useful in addressing land-use conflicts and allocation of land for alternative purposes.

The above discussion suggests that for each economic valuation model developed, there can be two resource values, one on a m^3 basis, the other on a hectare basis. For each of these values, two resource criteria can be applied, that is, based on current consumption and AAC. Therefore, each model can have a total of four alternative resource values for each accounting stance.

4.3 MODEL 1; GROSS EXPENDITURE VALUE TO GOVERNMENT

4.3.1 Background

The lack of adequate resource values in forestry has parallels with other resources such as water and recreation. These latter resources generally lack market determined prices and may only exhibit values determined through political process. Like forests, these resources are largely owned by the provincial governments in Canada. Given the similarities between these resources in terms of their pricing or valuation, an initial approach for valuing forest resources may be found among methods for evaluating water and recreation resources.

One of the earliest methods applied in valuing recreation resources in the United States was to assume that the benefits of recreation to users were equal to the costs of establishing recreation facilities (Seeley, 1973). The theory that costs in some form substitute for benefits has been generally accepted by some schools of thought on the basis that measuring costs is far easier than measuring benefits (Steiner, 1966). Estimating the costs of establishing recreation facilities is relatively straightforward, however applying this concept to forestry is unsatisfactory. In Canada, forests to a large extent are still virgin stands. The cost to the resource owner (the provinces) of providing these forests to industry could theoretically consist only of the opportunity cost of inadequate stumpage prices. Clearly, this approach leads up a blind alley.

A modified approach used in recreation at present may be more appropriate. Non-simulation methods of evaluating recreation resources are favoured because of their simplicity and ease of implementation (IMPACT Environomics Ltd., 1976). Included is the gross expenditure method which measures the value of recreation based on total expenditure by recreationists. The intuitive argument is that the value of a day's recreation is worth at least as much as the money spent by the user for the recreation visit (Knetsch and Davis, 1966). In terms of forest resources, their value to government may at least be partially represented by the level of expenditures needed to maintain the resource base. This approach appears relatively simple and would use data generally available. There are however, weaknesses which must be recognized. First, non-simulation methods fail to provide a measure of willingness-to-pay or consumer surplus. Secondly, these approaches fail to value losses if the resource opportunity disappears. Thirdly, the method has an inability to show the net gain in value from increasing resource opportunities (Knetsch and Davis, 1966).

An alternative approach is to apply market simulation methods which provide a measure of consumer surplus. Specific methods include the Hotelling-Clawson and Pearse techniques which are based principally on travel costs by recreationists and the estimation of a market demand curve for the particular recreational opportunity. Although more meaningful estimates of value are obtained by market simulation methods, there are also inherent weaknesses as well. First, in cases where there are a number of recreational opportunities at a specific site, there may be confusion as to which values are being measured. Secondly, recreationists may seldom travel to a single site, especially on a longer journey. Travel costs will therefore be spread over a wide range of recreational areas. Thirdly, questionnaire surveys to solicit travel cost data from recreationists are usually expensive and require assumptions that all respondents answer accurately.[5]

Both approaches have their own faults, however in terms of simplicity, availability of data, and ease of calculation, the non-market method of gross expenditure is most appropriate for this study. If one accepts that gross expenditure can provide minimum estimates of resource value and recognizes the conceptual faults, the method can be applied to forest resources as defined in this thesis. The validity of the model can only be assessed once data are used and results obtained. This process will occur in the next chapter.

4.3.2 Provincial Accounting Stance

Using a provincial accounting stance, the main costs to consider for the model are the gross expenditures by the provincial government related to the forest resource. The primary role of any provincial government with respect to forest resources for timber production is one of ensuring a continuous flow of timber under sustained-yield management. Sustained-yield policies are favoured because they promote the most likely conditions for maintaining an even-flow of timber and social benefits from forestry production. A more detailed discussion of this subject is provided in a later section (4.52-(a) 5) in this chapter under the heading of community stability. Provincial responsibilities include mensuration and inventory, silviculture, planning, protection, administration and policy, all of which relate to forest management. In addition, there may be responsibilities associated with wood product development and marketing, access road construction and

[5]For a more detailed discussion of these weaknesses, the reader should refer to (IMPACT Environomics Ltd., 1976).

maintenance, and environmental protection. Many individual departments may be involved which will incur expenses related to the forest resource in the province. As an example in Newfoundland, the following provincial departments have, in recent years, conducted programs related to forestry:

	Department	Forestry Related Function
1.	Forest Resources and Lands	All aspects of forest management, administration and policy.
2.	Development	Feasibility studies of new mills, technology transfer to industry.
3.	Mines and Energy	Development of wood energy technology and administrating grant programs.
4.	Environment	Environmental assessment of forestry operations within Provincial regulations.
5.	Labour and Manpower	Assistance with jointly funded forestry job creation programs.
6.	Rural, Agricultural and Northern Development	Funding programs in the sawmill sector.

From the previous list, the department with the greatest overall responsibility for maintenance and development of the forest resource is the Department of Forest Resources and Lands. Therefore, the expenditures of this department are the primary costs to consider for the model. A similar situation likely exists in most other provinces. For the Newfoundland situation, an analysis of the individual directorates, or sub-groups of the department would be useful at this point.

Directorates-Dept. of Forest Resources and Lands-1983	Directorate Functions
1. Forest Management	Management planning, forest administration, reforestation and forest improvement, research and development related to forest management, forest inventory.
2. Forest Products Development	Industry development programs for the wood-industries sector, sawmill administration, development of harvesting and processing technology.
3. Forest Resource Roads	Construction and maintenance of forestry road network.
4. Forest Protection	All aspects of forest protection from fire, insects and disease, public education programs.
5. Labour Intensive Forest Management	Forest improvement and site rehabilitation associated with job-creation programs.

There is also an administration cost associated with each directorate, plus the cost of operating satellite forest unit offices throughout the province. As well, one must include the cost of executive support services which includes the Minister and staff of the Minister's office, plus senior executives such as the Deputy Minister. In summary, the costs to include in this model are all major expenditures by the provincial government associated with maintaining the forest resource base and related infrastructure.

One question which arises is the treatment of capital expenditures for roads and buildings, as well as investments in forest capital through reforestation. There are alternative schools of thought regarding capital investments in forestry. For investments in roads and buildings, one can treat these as depreciating fixed assets. The initial cost can in theory be spread over the life of the asset using either the straight-line or declining balance depreciation methods. However, these methods of spreading out capital costs may not be appropriate for government expenditures. In a profit-seeking business, depreciation and capital gains associated with fixed assets are important considerations, especially for tax planning. In addition, the actual decision to purchase a capital asset may require the borrowing of funds and analyses to assess the economic feasibility of alternative capital investments. Techniques include break-even analysis (Mumey, 1977), minimum payout, discounted net worth, and capital budgeting (Duerr *et al*, 1975). One must realize that investment decisions for roads and buildings require different criteria between industry and government. In business, rates of return and profitability after taxes are the prime criteria. On the other hand, a provincial government department making the same expenditures is not concerned with borrowing investment capital, paying taxes, or achieving profits. Therefore, a more appropriate method for considering government expenditures on roads and buildings is to treat costs as annual expenditures. As an example, if in one year capital costs are $5,000,000, these expenditures are simply assumed to be that year's cost of maintaining the forest infrastructure.

Silvicultural costs can be treated similarly. One school of thought views reforestation and stand tending costs as investments in forest capital; see for example (Anderson, 1979; Carroll, 1978; Forster, 1969; Fedkiw and Yoho, 1960). The underlying principle in this approach is to calculate net present value based on final product worth and initial treatment costs. A second approach, used commonly by the forest industry in Canada, views silviculture costs as annual expenses simply deducted from current harvest revenues; see (Reed, 1979) for example. The annual expense approach is more valid for government expenditures in the same manner as for roads and buildings. These expenditures are made each year to maintain the stock of forest capital after losses through harvesting, fire, insects and disease etc. have occurred. In addition, this approach avoids the problems of using inadequate forest resource values (usually stumpage) in the net present value calculations, and decisions over the appropriate rate of discount to use.

An additional cost incurred by provincial governments in relation to forestry is the funding contribution to post-secondary education in forestry training. As an example in Newfoundland, the government contributes funds to Memorial University which provides the initial two years of B.Sc. Forestry training. Also, funds are provided to the College of Trades and Technology which offers a two year technical diploma program in forestry. The training of foresters and forestry technicians can be viewed in a similar manner to silviculture and roading expenditures, that is the costs are a carrying charge to maintain the forest resource and related infrastructure, in this case supervisory personnel. Given that data on such expenditures are available, forestry education costs should be included in this model.

In summary, the main expenditures to consider in this model are provincial government costs associated with managing the forest resource. The main source of expenditures to include are from the Provincial Forest Service. Costs for capital investments such as roads, buildings and reforestation should be viewed as annual expenditures required to maintain the forest resource base and related infrastructure. From a provincial accounting stance, the model equates provincial government expenditures on forestry with the value of the resource to the provincial government.

4.3.3 Federal Accounting Stance

From a federal accounting stance, the gross expenditure model assumes federal expenditures to a provincial forestry sector are equivalent to the level of benefits, or value received. Direct federal expenditures related to forestry occur in a number of ways through several departments. Using Newfoundland as an example, there have been five main departments involved in the forestry sector in recent years;

Department	Forestry Related Function
1. Agriculture	Includes the Canadian Forestry Service with responsibilities for forest research and implementation of forest sector development agreements and job creation programs.
2. Regional Industrial Expansion	Implementation of grants and related programs for industrial modernization and expansion.
3. Energy, Mines and Resources	Allocation of funding for development of wood-energy technology.
4. Canada Employment and Immigration Commission	Technical and in some cases financial assistance with forestry sector job creation programs delivered through other departments.

5. Environment	Monitoring of federal regulations related to environmental protection.

Of these main departments involved with forestry at the provincial level, the Canadian Forestry Service (Department of Agriculture) and the Department of Regional Industrial Expansion are the two incurring the majority of federal expenditures.

One point to consider is the merit of including research expenditures by the Canadian Forestry Service (CFS). At present, the spatial distribution of regional and national research establishments is as follows:

Establishment	**Location**	**Area of Responsibility**
1. CFS Headquarters	Hull, Quebec	National
2. Petawawa National Forest Institute	Chalk River, Ontario	National
3. Forest Pest Management Inst.	Sault Ste. Marie, Ontario	National
4. Pacific Forestry Centre	Victoria, British Columbia	British Columbia, Yukon
5. Nothern Forestry Centre	Edmonton, Alberta	Alberta, Saskatchewan, Manitoba, N.W.Territories
6. Great Lakes Forestry Centre	Sault Ste. Marie, Ontario	Ontario
7. Laurentian Forestry Centre	Quebec City, Quebec	Quebec
8. Maritime Forestry Centre	Fredericton, New Brunswick	New Brunswick, Nova Scotia, Prince Edward Island
9. Newfoundland Forestry Centre	St. John's Newfoundland	Newfoundland, Labrador

The federal government also funds forestry research through grants and contributions to non-government research organisations. These include the

Pulp and Paper Research Institute, Forest Engineering Research Institute, FORINTEK (forest products research) and Universities.

There is a strong case for including federal expenditures on forestry research in the same manner as for expenditures on roads or silviculture. Research expenditures are required to maintain and improve the stock of knowledge relating to all aspects of forestry including ecology, management, production, marketing, economics and policy. A strong research program is very important to a nation such as Canada which depends heavily on the forestry sector for economic growth and development.

There may be practical problems in determining the value of research expenditures in one specific region. As an example, the CFS research lab in Fredericton serves three provinces, however the bulk of actual expenditures on salaries and operations will undoubtedly be made in New Brunswick where the lab is located. While the other two provinces benefit from the research program, they do not receive comparable shares of cash expenditures. Similarly, a national research institute benefits the forestry sector across the country while concentrating expenditures within the region where the institute is located. To estimate the value of federal research expenditures in one specific province such as Newfoundland, a shadow price must be derived. Perhaps the simplest technique is to divide total federal forestry research expenditures in Canada by the area of productive forest in the province of concern. Therefore, the value of research expenditures is related directly to the size of the productive forest area in any province and takes into account research benefits transferred from other regional or national institutes.

Federal contributions to forestry education at the post-secondary level should also be included in the model for the same reasons as provincial forestry education expenditures. The availability of data may be a limiting factor, however these expenditures must at least be recognized in the model.

The major federal expenditures relating to forestry are direct contributions to provincial and industrial forest management programs through cost-shared Forestry Subsidiary Agreements and various job-creation programs. These expenditures are made in every province where Agreements currently exist. Thus, in the case of the Maritimes Forestry Centre for example, expenditures flow to each of the three provinces within the region. Therefore, problems of cost accounting are greatly reduced. These expenditures can be quite significant. As shown in chapter 2, federal forestry expenditures through cost-shared Agreements in Newfoundland have exceeded $100 million over the past decade. These contributions account for approximately 40 percent of the provincial government's forestry budget. In contrast, the Newfoundland Forestry Centre's operating budget for research over the same time period was less than $20 million in total.

The treatment of federal expenditures on capital items and silviculture in a provincial forestry sector should be similar to that for the provincial accounting stance. These expenditures are viewed simply as a federal commitment to maintain forestry infrastructure and forest stocks in any particular province.

The treatment of expenditures by the Department of Regional Industrial Expansion also merits discussion. While financial contributions to mill modernization, expansion of capacity, or indeed for a new mill are related to forestry, they are not expenditures directed at the forest resource itself. Obviously, a major change in mill capacity in a province through federal funding may influence the level of consumption of fibre. However, the expenditures do not maintain or improve the growing stock or level of forest management. In general, a major increase in forest resource consumption should lead to an increase in forest management expenditures by the provincial forest service. Therefore, the model should account for changes in mill capacity and resource consumption.

In summary, from a federal accounting stance, the model assumes that direct federal expenditures related to a provincial forest resource represent the level of benefits or value to the federal government. The main sources of expenditures are grants and contributions to the province and industry from the Department of Agriculture, through the Canadian Forestry Service. Of lesser importance are the federal expenditures on forestry research and education.

4.3.4 Summary of Gross Expenditure Model

This model is very simple and assumes that the gross expenditure related to the forest resource by a government is equal to the level of benefits received. There are many weaknesses in this approach, however the method is easy to apply and yields results which do reflect some measure of value for forest resources. One question which the model does not address is whether the level of expenditure by government is optimum, or even adequate to maintain forest infrastructure and growing stocks. One can only assume that given budget constraints and competing interests for funds, government expenditures in forestry reflect the political perception of the resource and industry's value. A large willingness to spend scarce funds in the forestry sector indicates a high level of value placed on the sector by politicians involved in funding decisions. The opposite situation with low expenditures reflecting a low perception of value would also be true. In addition, one should note that some government expenditures made in a given year may not result in immediate benefits. However, it would be extremely difficult to separate expenditures on this basis with any degree of precision. This weakness must simply be recognized.

Obviously, the level of expenditure will change each year, not only to account for inflation, but also in response to a perceived need to alter funding. As an example in Newfoundland, expenditures on forest protection and intensive management have increased greatly in response to damage caused by the spruce budworm over the past decade. Similar examples exist in western Canada with expenditures suddenly increasing to ameliorate the effects of drastic forest fires in certain years. Therefore, simply using one year's data in estimating forest resource values with this model could yield results widely variable from normal expenditures. To reduce this problem, an average value should be calculated, based on several years of data. This would likely smooth out wide fluctuations in government expenditure and resource consumption. The specific details of any averaging method will be discussed in the next chapter where data are used in the model.

4.4 MODEL 2. NET INCOME VALUE TO GOVERNMENT

4.4.1 Background

The previous model, based on gross expenditure, only considers government costs related to forestry. The concept of net value is not addressed. A more effective model therefore, should include measures of both costs and benefits from a government perspective. One approach to consider is that of net income. Basically, the method compares some elements of government revenue received from the forestry sector with government expenditures made to the forestry sector.

In Canada, there is currently a growing public awareness of the revenues received by governments from the forestry sector. Terms such as fiscal income, forest sector revenue and public revenue are all used to describe the funds transferred to government from industry via taxation, royalties and miscellaneous fees. There have been numerous studies of these revenues both at the provincial and national level. See for example:

Study	Region
(Howard, 1978)	British Columbia
(White, 1982)	British Columbia
(Reed *et al.*, 1973)	British Columbia
(Milne, 1981b)	Newfoundland
(Smyth, 1977)	Ontario
(Smyth and Ramsay, 1983)	Ontario
(Anon., 1981a)	Ontario
(Nadeau, 1981)	Quebec
(Reed *et al.*, 1978)	Canada

Most of these studies evaluate only the revenues gained by government. Three studies also include an evaluation of government expenditures. Only one study however, the national report by Reed *et al.*, (1978), directly compares government revenues and expenditures related to forestry. This approach must be followed to obtain a net value for forestry.

The main source of government revenue from forestry is received through various forms of taxation. One conceptual problem which consistently arises is deciding which taxes are to be included. The studies previously cited have generally included taxes paid by both the industry and employees. Therefore, direct taxes such as corporate and personal income tax are included as well as indirect taxes such as sales tax. This approach of including all possible taxes paid by the forest industry and employees is valid if one is only considering the revenue side of the equation. The taxes represent a transfer of income from corporations and individuals to government for redistribution to society as a whole. Therefore, the tax revenues can be viewed as a transfer within society, but a positive gain to government.

Theoretical problems arise when comparisons between government forestry revenues and expenditures are made. The study by Reed *et al.* (1978) on a national basis is an example of the accounting problems which can occur. On the revenue side, direct and indirect taxes from both the forest industry and employees are estimated. On the cost side however, only government expenditures to the industry are estimated. Therefore, the net income measures are overestimated on the revenue side.

This accounting problem can be tackled in either of two ways. The first approach would be to estimate the government benefits received by the employees of the forest industry. If one credits the forest industry employees with the generation of public revenues, then one must also recognize the government's cost of providing social services to these employees. Therefore, estimates of government expenditure on education, health, defense, transportation etc. would have to be calculated for the forest industry employees. These figures would be extremely difficult to estimate, and the degree of precision might be very low. This problem was recognized in one of the Ontario tax studies (Anon., 1981a).

A second and more practical approach would be simply to omit employee taxes from the analysis, thereby eliminating the need to estimate government expenditures to employees. There are two arguments in support of this approach. First, estimating employee taxes in itself is difficult and requires many assumptions about employees in the absence of published data. For example, to estimate sales tax revenues generated through employee expenditures, one must make several assumptions regarding employee patterns of saving and expenditure, or undertake extensive surveys to collect the necessary data.

The second argument in favour of omitting employee taxes is more theoretical. If one included employee taxes, the gross value to government is directly related to employment levels as well as average incomes. Two paper mills for example, may produce identical levels of output yet could have entirely different employment levels. Variations in plant technology and capital/labour ratios between the mills would influence the number of employees hired. The mill with more employees will obviously generate a larger level of employee-derived taxes. In comparison, the mill with the greater capital/labour ratio may not generate an equal level of public revenues through sales taxes on capital expenditures. The point is that employment levels and employee taxes are not consistently related to output. Capital-labour substitutions can alter the flow of employee tax revenues without changing industrial output.

Conversely, corporate taxes are derived from industry income and output. If production levels fluctuate, corporate income and resulting taxes will also change. Most important, corporate taxes are not directly related to employment levels. Therefore, in the preceding example, both mills with identical output may have very similar net incomes and hence corporate income taxes. This statement assumes equivalent operating efficiencies and cost structures.

The net income model to be developed in this chapter will use forest industry public revenues as representing gross government income from forestry. These revenues would include corporate taxes and various other government levies such as stumpage. For a measure of cost, government expenditures to the forestry sector as defined in Model 1 will be used.

4.4.2 Provincial Accounting Stance

Each province assesses a variety of taxes on the forest industry. While some taxes are similar among the ten provinces, the tax rates may differ widely. Using Newfoundland as an example, the following provincial government taxes are assessed on forest industry firms;

1. Corporate Income Tax

Provincial corporate income taxes are expressed as a percentage of taxable corporate income and are collected by the federal government on behalf of the provinces. In 1981 the tax rate in Newfoundland was 15 percent while small businesses were assessed at a reduced rate of 12 percent.

2. Retail Sales Tax

The retail sales tax is levied by the province on the purchase price of most tangible goods and some services sold within the province. Retailers act as agents for the Crown by collecting and forwarding the tax to the provincial government. The retail sales tax is currently the largest generator of fiscal revenues in Newfoundland. In 1981 the tax rate was 11 percent. Exemptions include insulation, food and children's clothing. Therefore, most purchases by forest industry firms in the province are taxed.

3. Gasoline and Fuel Taxes

Most sales of gasoline, diesel fuel and fuel oil are taxed in Newfoundland. The tax rate on gasoline in 1981 was 7.1 cents per litre. Diesel fuel was taxed at 8.2 cents per litre. Fuel oil was taxed at approximately one quarter of a cent per litre. The three sectors comprising the forest industry in Newfoundland are subject to various exemptions. For logging, only gasoline and diesel fuel used in trucking of wood or in road construction are taxed. Fuel oil is 100 percent taxed. In the forestry manufacturing sector, gasoline and diesel fuel are 100 percent taxed, while fuel oil is generally exempt.

4. Forest Management

The 1974 Forest Land (Management and Taxation) Act introduced a forest land management tax, the details of which were presented in chapter 3. The tax rate on managed forest lands in 1981 was $0.23 per hectare and was assessed on all forest lands under tenure to the industry in the province. In addition to these main provincial taxes, the forest industry in Newfoundland also is assessed for fees by the Department of Forest Resources and Lands. These are stumpage, cutting permits, sawmill licences and timber lease rentals, and were discussed in chapter 3. As a summary, recent charges for these are;

- Cutting permits: $2.00 annually.
- Timber lease rentals: $0.77/km^2 assessed on paper company licenced and leased areas annually.
- Sawmill licence: $20.00 annually.
- Stumpage charges: assessed on commercial cutting except for Corner Brook and Grand Falls paper mills. See Table 17, chapter 3 for recent rates.

The previous taxes and fees represent the main public revenues collected by the provincial government. Therefore, these revenues can be used to indicate government income from forestry through the harvesting and processing of timber in the province. To obtain a net income figure, the costs incurred by the provincial government in maintaining the forest growing stock and infrastructure must be deducted. These costs were discussed in detail in this chapter under the first valuation model, section 4.3. The net income figure can then be used to value the provincial forest resources on a per hectare and per m^3 basis.

4.4.3 Federal Accounting Stance

Under a broader federal perspective one can estimate the net government income resulting from forestry activity in any one province. The federal government collects specific tax revenues from the forest industry in each province and also incurs costs as discussed under the first valuation model. The main taxes assessed by the federal government are:

1. Corporate Income Tax

Forest industry firms in all provinces pay a federal corporate income tax, levied as a percentage of taxable corporate income. In 1981, the federal tax rate was 46 percent. Firms engaged in manufacturing and processing were assessed at a reduced rate of 40 percent. Therefore, the logging industry is taxed at 46 percent while wood industries and pulp and paper are taxed at the lower rate of 40 percent. These rates apply to large corporations. The federal corporate income tax rate for small businesses was 25 percent in 1981.

2. Federal Excise Tax

A federal excise tax is collected on all goods produced in, or imported into Canada except for specific exemptions. The tax rate on materials and supplies, gasoline and diesel fuel was 9 percent in 1981, applied to the manufacturer's selling price, or duty paid value if imported. The tax rate on building and construction material was 5 percent in 1981. In forestry, machinery and equipment used in production are generally exempt. Gasoline and diesel fuel are not subject to exemptions.

These two taxes comprise the major sources of federal revenue from forest industry firms. This gross income figure can be transformed to net income by deducting federal government expenditures to the forestry sector in the province of interest. These expenditures were described in detail in section 4.3.3 of this chapter.

4.4.4 Summary of Net Income Model

This model is an improvement over the gross expenditure approach in that a net value of forest resources can be estimated. Gross income received by government is represented by public revenues assessed on forest industry firms. At the provincial level these revenues include taxes and forestry fees; at the federal level only taxes are considered. The model does not include tax revenues paid by forest industry employees. There are sound theoretical reasons for excluding these taxes despite the fact that they can be of considerable importance to government treasuries. The cost factors in the model are the same as those developed in the gross expenditure model that is, government expenditures to the forestry sector.

As with the first model, using one year's data is less desirable than calculating an average value based on several years of data. While tax revenues are closely linked with production and industry income, an influencing factor is changing tax rates. While such changes are not usually of a great magnitude, even marginal changes will affect tax revenues collected. Also, as discussed in the first model, government expenditures related to forestry are subject to fluctuations each year. Therefore, a net income value based on several years of data is suggested.

4.5 MODEL 3; NET SOCIAL VALUE

4.5.1 Background

The two previous models provide a simple framework for valuing forest resources on the basis of financial costs and benefits from a government's perspective. These approaches are useful but will not yield optimum estimates of value. A broader approach, based on some measure of social costs and benefits, should provide better estimates. From the discussion of value theory in chapter 3, the reader may recall that the concept of net social benefits reflected an optimum approach to resource valuation. In theory, this method requires the quantification of **all** benefits and costs incident upon society. This approach is extremely difficult to implement in practice because of inadequate data and the lack of explicit values for many costs and benefits.

A more realistic approach is to narrow the scope of analysis. Rather than attempting to quantify **all** benefits and costs incident upon society as a whole, the model should evaluate the major social costs and benefits based on the flow of productive services from the harvesting and processing of commercial timber. This approach is valid if one assumes that net benefits to the economy and public sector as a whole at least partially reflect a general view of society. Therefore, forestry derived benefits such as employment for example, are defined as social benefits in this model. An implicit assumption is that in commercial forests, timber production is the main objective. This assumption would appear to be valid based on the situation in Canada. On leased and licenced areas, timber production and consumption tends to be the priority use with alternative uses such as recreation, grazing or hunting being integrated where possible. The widespread use of clearcutting in Canada also limits the opportunity for multiple-use resource management as practiced in some European countries such as Yugoslavia, under a selection cutting system.

A logical starting point for this model would be first to identify and describe the major social benefits and costs associated with commercial timber production. These benefits and costs can be discussed in the context of two accounting stances. However, rather than using each level of government as the basis for accounting, this model will use the broader perspective of a provincial and national economy.

4.5.2 Social Benefits From Commercial Forestry

There are two broad categories of social benefits which require discussion. The first type is economic benefits to the province or Canada as a whole from commercial timber production. The second type is extramarket benefits such as enhancement of forest access for non-consumptive uses such as recreation.

a) Economic Benefits From Timber Production

1. Value of Shipments and Industry Revenue

Value of shipments is a useful criterion to evaluate the contribution of an industry sector towards the total value of goods produced in an economy over a specific time period. As shown in chapter 2, the Newfoundland forest industry is a major contributor to the total value of output in the province's manufacturing sector. Of greater interest however, is the value of exports from these shipments. Exports are important in terms of the exogenous income received. This income is critical to economic growth in the long-term, a factor stressed in regional development theories such as the staples and regional science approaches. The staples approach relates to the development of a specific regional economy through the export of natural resource products such as fish, wood, minerals and grain. These "staple" products earn income which can be used to pay for imported products not available in the region. Economic growth therefore, depends upon the marketability of these natural resources (Economic Council of Canada, 1977). The regional science approach emphasizes the importance of population distribution and industrial structure in explaining regional economic growth. As with the staples theory, exports are viewed as being critical for the region to earn income to purchase imports. From a provincial accounting stance therefore, exports play a major role in economic growth. At the national level, exports also are important through the earning of foreign exchange. In the Canadian situation of flexible exchange rates, exports create a demand for Canadian dollars which in turn exerts upward pressure on the value of the Canadian dollar *viz-a-viz* other currencies.

From the viewpoint of society, revenues earned by industry from the sale of final products such as newsprint or lumber, represent a gross income from which expenditures are made and profits retained. This gross income is therefore the cornerstone of economic activity and resulting social benefits, a theme addressed in more detail in the following sections.

2. Industry Expenditures

Industry expenditures associated with the harvesting, processing and marketing of forest products include payments for a wide range of inputs. These inputs include wages and salaries for labour, operational materials, supplies and services, capital investment, maintenance, and repair. From a provincial accounting stance, the benefits to society arise from the injection of income for expenditures made within the province. This initial injection of income can have a great impact on regional income levels. Over a period of time, through subsequent circulation of the income, leakages will occur from taxes, savings and expenditures for imported goods and services. As an example, a local business may initially receive forest industry expenditures for chain saws. However, if the saws must be imported into the region, the local income benefits are much smaller than the actual cash payment. Certainly, in an economy like Newfoundland with its weak economic base, the leakage of forest industry income may be quite high.

Expenditures by the forest industry made outside the province are not included as benefits using a provincial accounting stance. From a broader national view however, these expenditures make a contribution to economic activity in the regions receiving the income.

3. Employment and Income

As illustrated in chapter 2, employment from forestry can be rather significant both at the provincial and national level. The primary source of forestry employment is industry labour related to harvesting, processing and management of forest resources. In most provinces therefore, the employment is generated in the logging, pulp and paper, and wood industry sectors. From a provincial perspective, the social benefits of employment arise from the generation of economic activity in predominantly rural areas. In Newfoundland, employment opportunities in rural regions are scarce and in many cases, forestry provides the major source of employment. Using simple with/without criteria, forestry employment must be considered an important social benefit especially in regions where alternative employment opportunities are lacking.

Associated with forestry employment is the income through wages and salaries as a factor of production. From a national accounts view, these incomes represent a contribution to provincial and Canadian gross domestic product. The income paid to employees also generates economic activity in much the same manner as other industry expenditures. A portion of gross income is taxed, saved or spent outside the region from a provincial accounting stance. However, the remaining income will be spent within the province on goods and services in the business community.

Employee expenditures, in conjunction with other industry expenditures can have a powerful effect on local economic activity. The direct employment and income will generate indirect impacts as well, through the multiplier effect. In forestry, the forward and backward linkages with other sectors of the economy are particularly strong (Nadeau, 1981). Finance, retail trade, petroleum, and service and supply sectors all benefit from direct forestry employment and income (Milne, 1982).

The importance of forestry employment and income will increase in relation to the general level of economic activity in a particular province. As an example, forestry-derived employment and income in a province with low unemployment and a strong, diversified economy may not be viewed with great importance by the government. In this case, there may be numerous opportunities for alternative means of earning income. Conversely, in a province with chronic high unemployment, a weak economic base, and a heavy dependence upon forestry for economic activity, the government may view forestry with greater importance. Therefore, a government's perception of the social value of forest resources and forestry may be strongly influenced by the level of unemployment, availability of alternative economic opportunities, and the contribution of forestry towards total employment and income.

4. Value Added

Value added is the value which is added to raw materials or other goods and services as they pass from one stage of production to the next (Beckerman, 1969). Using a forestry example, assume industry A (a logging company) sells roundwood to industry B (a sawmill) for \$50.00 per cubic metre. The sawmill produces finished lumber which it sells to industry C (a furniture plant) for \$100.00 per cubic metre. The lumber is then used to manufacture furniture which sells for the equivalent of \$200.00 per cubic metre. The total value added to the raw wood input as it passes through various stages of production equals \$150.00 per cubic metre ([\$200/m^3 - \$100/m^3] + [\$100/m^3 - \$50/m^3]).

Value added is calculated by subtracting the costs of all purchased inputs of production from outside the plant, from the selling value of the finished product. Value added includes returns to labour (wages and salaries), the cost of capital (interest, rent, depreciation) and the return to the enterprise (profit). Alternatively, one can estimate value added by summing these three factors separately. From a national accounts perspective, value added is a measure of an industry's contribution to gross domestic product (Garston and Worton, 1968).

At the provincial level, value added is an important measure of local economic input for any sector of the economy. Value added can be influenced by many factors, for example if one uses the residual approach, factors affecting the selling price of the product or the cost of purchased inputs will be important. If one is summing the components of value added, factors such as interest rates and wage levels will be important. At the national level, value added from one province simply contributes to the national aggregate. As a measure of welfare, value added has several limitations, the most serious being the omission of non-market goods and services. Many of these outputs such as pollution are associated with the production of market goods and are unwanted social costs (Lecomber, 1978). Therefore, value added may not fully measure social benefits and costs arising from forestry activity.

5. Community Stability

The social objective of community stability in rural areas is a widely recognized goal of governments in Canada. The policy of sustained-yield forest management is the means by which provincial governments ensure regulated long-term supplies of wood input are available to the forest industry. This "even-flow" of fibre is thought to help maintain forestry output and hence economic activity. This policy is especially important for one-industry towns based largely upon timber harvesting and processing.

Does forestry activity through sustained-yield management ensure community stability? There is growing evidence that the answer is no. A study by Byron (1978) in British Columbia, showed that community stability was linked more to market prices of forest products rather than the even-flow of wood input. World prices for forest products, market power of individual mills, and the general competitive position of the industry all appear to be factors which influence economic activity in forestry-based communities. In the longer-term, there is no guarantee that a specific processing plant will continue to operate and maintain the necessary capital investments to offset deterioration of equipment. Therefore, the presence of forests and an even-flow of wood input do not ensure community stability. As a result, community stability cannot be considered a social benefit arising from the harvesting and processing of forest resources.

Approaching this question from a different angle however, suggests that many communities in Canada as well as Newfoundland are **dependent** upon forestry to maintain economic activity. As an example, there are approximately 300 communities in Canada with at least 30.1 percent of their experienced labour force employed in forestry work. According to Hornberger (1974), a community would be financially dependent upon an industry if the industry accounted for as little as 10 percent of the total labour force. Clearly, there are a large number of communities in Canada dependent upon forestry for providing the main source of economic activity. Where alternative resource developments or opportunities for economic activity are limited such as in many regions of Newfoundland, the forest industry is of critical importance to dependent communities.

b. Extramarket Benefits From Timber Production

As discussed briefly in chapter 3, forests provide a wide range of extramarket benefits in addition to timber, including soil stability, areas for recreation, wildlife habitat and recycling of oxygen. These benefits are rarely priced in the marketplace. For example, on public lands in Canada, the price of a recreation visit at the park gate usually consists of a nominal licence or entry fee.

On forest lands in general, the extent and value of extramarket benefits can be significant. In one study in Alberta, Phillips and Carroll (1978) estimated that the value of fish and wildlife resources in 1977 was approximately $103 million. These benefits included licence fees plus the user's willingness-to-pay over and above recreation expenses for the right to participate in recreational activities. By comparison, the value of exports of Alberta forest products in 1977 was approximately $219 million (Anon., 1984a).

The preceding example applied to all forests, both commercial and non-commercial. Also, fish and wildlife benefits from non-forested land were included. The value of extramarket benefits on commercial forests used primarily for timber production is difficult to assess. For example, on large timber leases, public access may not be guaranteed. In Newfoundland, public access on lease and licence land is protected, however on freehold lands, public access is restricted. On unalienated Crown lands where sawlogs and fuelwood are extracted, public access is also preserved. Therefore, on most forest land used for fibre production, the potential extramarket benefits from public access such as fish and wildlife must have some implicit value to society.

A second factor which implies that some level of value is associated with extramarket resources, is the regulation of harvesting practices in Newfoundland. By establishing regulations over timber harvesting, extraction and roadbuilding, a degree of protection is provided for non- timber resources such as water, fish and wildlife. Thus, a policy of safe minimum standards is prescribed (Wantrup, 1968). This approach addresses situations where a consumptive resource use could have irreversible consequences on other resources. By carefully regulating the consumptive use (commercial forestry), non-timber outputs can be protected to a certain extent. Given these factors, one must acknowledge that in Newfoundland, extramarket benefits exist on forests used primarily for timber production.

There is an alternative view which must be discussed however. One should also recognize that increased public access into commercial forests and forestry operations in general, create social costs. In Newfoundland, public access on alienated forests has become an increasing concern to the newsprint mill tenants due to wood theft, vandalism of equipment, increased garbage, and damage to roads during wet weather. On unalienated forests used for sawlogs and fuelwood, public access has greatly contributed to these areas becoming a common property resource, characterized by lack of exclusive ownership rights, the inability of individual users to control rates of exploitation, and the absence of incentives to conserve the resource (Pearse, 1977). Despite government regulations and efforts to control the situation, public pressure on forests, fish and wildlife resources in some regions is a growing problem. Thus, while roads are built initially for use in timber extraction (say for sawlogs), public access allows exploitation and deterioration of non-timber resources.

Forestry practices which incorporate large clearcutting operations also can create social costs for non-timber resources; the presence of regulations to protect the environment for example, is clear evidence of this fact. In

Newfoundland, the favoured harvesting practice of the pulp industry is clearcutting. The literature in Canada cites numerous studies of the negative impacts arising from clearcutting, even in spite of environmental regulations.[6] These impacts include soil erosion, loss of site productivity, increased stream flow, reduced water quality, damage to fish and wildlife habitat and population levels, increased timber blowdown, and reduced aesthetic values. When a selective cutting approach is followed, for example on private woodlots in the Maritimes, or by some sawmillers in Newfoundland on unalienated Crown forests, these negative environmental impacts may be less of a concern.

The central question of extramarket benefits and costs associated with timber production becomes one of balancing the opposing values. In commercial forests, timber production is the primary land-use objective, however extramarket benefits do result through increased access to the general public. On the other hand, social costs are created by the increased public access as well as through the course of normal forestry operations. Whether these social benefits and costs cancel each other, or are skewed in one direction is difficult to determine. From a practical perspective, the measurement of these values is a formidable task and lies beyond the scope of this thesis. The most realistic course of action is to recognize the existence of extramarket benefits and costs. While no accurate quantitative values can be assigned, these benefits and costs are still acknowledged.

4.5.3 Social Costs From Commercial Forestry

An economist's definition of social cost invariably encompasses the term opportunity cost. Generally, opportunity cost from a particular commitment of resources consists of benefits foregone in the most productive alternative use of those resources (Howe, 1971). In this study there are three types of opportunity costs one may consider which arise from commercial timber production. The first type is the financial costs incurred by government and industry, associated with the harvesting and processing of timber. The

[6] The reader should refer to (Dancik, *et al*, 1979) for a thorough discussion of this issue.

second type is the opportunity cost of the forest land base itself in relation to alternative land-uses. A third social cost to consider is the extramarket costs such as pollution caused by timber harvesting and processing.

a) Opportunity Cost of Expenditures

The expenditure of government and industry funds in association with the harvesting and processing of commercial forests can be considered an opportunity cost in strict theoretical terms. One may simply evaluate the potential gains from making these expenditures in other sectors of the economy. Alternatively, one may value the opportunity cost by assigning an interest rate and treating the expenditures like an investment.

These approaches may not necessarily apply to the model being developed in this section. Industry expenditures are viewed as the engine behind the social benefits to an economy through employment, incomes and purchases of materials and supplies. While these are private costs to industry, they are also social benefits in a broader view. The approach in this model is to treat industry expenditures as a social benefit. Industry expenditures are required to produce a certain level of output from forest resources. Industry will receive returns (if positive, in the form of profits) which are only one component of the economic benefits accruing to society.

This model addresses the short-run situation of industry production in the current year. Industry is assumed to be committed to achieving a certain level of production each year based on their analysis of market demand which is often cyclical and frequently volatile. A decision is made to operate at a certain capacity with the commitment of funds for operational expenditures. Over such a short time horizon and in the context of this model, applying the concept of opportunity cost to industry expenditures is questionable.

The treatment of government expenditure related to the forest resource as an opportunity cost also warrants discussion. Certainly, these funds are allocated to forestry on an annual basis similar to industry expenditures. There are however two major differences to consider. First, government expenditures in themselves do not create social benefits in the same way as industry expenditures. Governments do not normally harvest and process timber in Canada from which social income can be created. Instead, the expenditures are primarily directed at maintaining the resource base and infrastructure in support of industry activity. The presence or absence of these expenditures will not influence industry's decision to harvest and process timber in the short-run. If these expenditures are not critical to the creation of social benefits by industry activity, they should be treated as an opportunity cost. In addition, one must recognize that funds allocated to forestry by government are extremely vulnerable to political influence. Priorities can change quickly and there is no guarantee that initial funding allocations will remain over any current budget year. These funds can easily be directed to alternative uses. Therefore, in this model, government expenditures to the forestry sector, as described in the two previous models, will be treated as an opportunity cost.

b) Opportunity Cost of the Forest Land Base

The central issue in any discussion of opportunity cost of the forest land base is one of alternative land-uses. Basically, one must ask if there are land-uses other than forestry which will yield greater economic benefits to society. Certainly, there may be situations where forestry is not the optimum land-use in a particular region. As an example, Hyde (1983) showed that in one forest region in Oregon, potential recreation values were likely greater than timber values under the constraints of sustained yield management and biological rotation ages. Timber values were based on stumpage prices calculated through competitive bidding.

One should realize that in Canada, conflicts do occur over land-use between forestry and other uses such as recreation, agriculture and hydro-electric development. In Alberta, forest land alienations through petroleum exploration and development were identified as a serious problem in a study by the Environment Council of Alberta (Dancik *et al*, 1979). In 1976 for example, the petroleum industry cleared 35,850 hectares of forest land while the forest industry accounted for 47,198 hectares. In Newfoundland, forest land alienations from 1960 to 1979 totalled 74,200 hectares with a loss in annual allowable cut of nearly 102,000 cubic metres (Anon., 1981b). On Crown lands, there appears to be an increasing level of competition by land-uses other than forestry (Draper and Storey, 1984).

Resolving land-use conflicts requires valuing each competing land-use. The central theme of this study is that forest resource values used by governments in policy decisions are inadequate. Invariably, most analyses of forestry use stumpage price as the measure of value which in Canada can often place forestry at a disadvantage. For this study, one should recognize that forestry may represent an opportunity cost of the land-base. However, the lack of realistic values means that land-use cannot be incorporated into the model. The values ultimately derived in this thesis can be applied to land-use conflicts and an example will be provided in chapter 7.

c) Extramarket Costs

The concept of extramarket costs was discussed in an earlier section in relation to extramarket benefits. As with extramarket benefits, the measurement of extramarket cost is difficult and lies beyond the scope of this thesis. One should at least recognize their occurrence and identify the major costs of concern in any analysis.

4.5.4 Indirect Benefits and Costs

So far, the model has only considered major direct benefits and costs from commercial timber production. One must also consider the inclusion of indirect or secondary benefits and costs. Indirect benefits can include employment and income in non-forestry sectors which are supported by forest industry activity. Indirect costs may include the public costs of providing infrastructure for these indirect employees and their families. At the local level, for example in a town supported by a single paper mill, indirect costs and benefits are very important. At the provincial or national level however, especially in a fully employed economy, secondary costs and benefits may simply cancel out and should be omitted from the analysis (Howe, 1971). In an underemployed economy such as Newfoundland, the positive secondary benefits may in fact outweigh the negative secondary costs. The computation of indirect impacts is difficult and including these variables tends to make any analysis more complex. Also the necessary data may not exist. In Newfoundland for example, there is a lack of measured multipliers for estimating indirect employment and income from forestry. To derive accurate multipliers requires the development of economic base models or input-output tables. Perhaps the best approach, in consideration of these problems, is to omit secondary impacts. Certainly in using the model in different provinces, the analyses will achieve greater consistency by concentrating on the direct benefits and costs which are more easily quantified.

4.5.5 Selecting Benefit and Cost Variables for the Model

The previous sections identified and described the major social costs and benefits associated with the harvesting and processing of commercial timber. For this model social costs are measured by the opportunity cost of public expenditures to the forestry sector. These expenditures were described in detail for the first two models and generally include funding contributions towards the maintenance of the forest resource and related infrastructure.

Extramarket costs and benefits are created by commercial timber production, however their inclusion into the model is constrained by poor data and often inadequate values. A range of socio-economic benefits arising from commercial timber production were also identified and described. Examples include employment and income generated through industry production, and expenditure on inputs such as labour, and materials and supplies.

At the provincial level, there are five main socio-economic benefits to consider as follows:

Z_1 value of shipments, forestry
Z_2 value added in production
Z_3 total forest industry employment
Z_4 direct income of employees
Z_5 industry expenditures excluding labour

These various benefits suggest three alternate approaches to developing the benefit side of the third model. The first approach is to construct a type of social welfare function such as (Equation 1):

$$V = f(Z_1, Z_2, Z_3, Z_4, Z_5) \qquad \text{(Equation 1)}$$

where V is the social value of a province's forest resources and the Z variables are the five socio-economic benefits discussed previously. Having defined the function, the problem then becomes one of developing a single measure of value. As it presently stands, the function provides a means of quantitatively describing the socio-economic benefits from forestry activity. However, a single value is required to combine with AAC or total consumption and the forest area, to produce a value of forest resources on a per m^3 or hectare basis. Developing a single measure from the five variables would appear to be a difficult task. First, how does one combine variables with different bases such as value added (dollars) and employment (person-years)? Second, there would be double-counting of some variables. As an example, value added already includes employee income. For these reasons, the social welfare function approach must be rejected for this model.

An alternate approach would be to use only similar variables combined into an average value. As an example, value of shipments and value added are closely related. Both variables can be used in national income accounting, and both have a monetary base. Therefore, one could simply calculate an average value for use in the model. This approach may have some merit, however there is a conceptual problem of averaging two variables which despite their similarities do not have the same basis. One must ask if an average of value added and value of shipments is very meaningful.

A third approach would be to select a single value from the list of five socio-economic benefits. From a theoretical point of view value added probably is the best variable to use. Because value added includes labour income, it provides a measure of employment benefits. From a social income perspective, value added is useful since it includes both industry and employee income. In addition, value added can provide a partial measure of social value, allowing for the omission of extramarket costs and benefits (Lecomber, 1978; Seidler and Seidler, 1975).

At the provincial level, this model will use the third approach with value added as the measure of social benefit and provincial government expenditures relating to forestry as the measure of social cost. A net social value can be computed and applied to wood consumption, AAC, or harvest area data.

From the previous paragraphs, an empirical description of both the provincial and federal net social value models can be provided. The provincial model is used to estimate a measure of net social value for commercial forest resources within the accounting framework of a province (Equation 2):

$$NSV_{pi} = \frac{[VA_{pi} - GE_{pi}]}{FR_{pi}} \qquad \text{(Equation 2)}$$

where: NSV_{pi} = net social value of provincial forest resources in year i to the province,

VA_{pi} = total value added from the forestry sector in the province in year i,

GE_{pi} = net provincial government expenditure to maintain the forest resource base in year i,

FR_{pi} = provincial forest resource variable; either total industrial wood consumption in year i, AAC, or area harvested.

The result is a net value, on either a per m^3 or hectare basis depending on the application desired. The value is based on measures of social benefits and costs from current timber production and consumption. Where time lags occur in data publication, past cost and benefit variables can be used. While some error would result from using past (albeit very recent) data as current estimates, the model still can provide an indication of net social value for policy purposes.

For a national accounting stance, a broader view is needed of the benefits and costs from forestry production in one province. On the benefit side, the value added component from Equation 2 is used to represent the contribution of forestry in one province to the national economy. On the cost side, both federal and provincial forestry expenditures within the province are used to represent social cost at the national level (Equation 3):

$$NSV_{ni} = \frac{[VA_{pi} - [GE_{pi} + GE_{fi}]]}{FR_{pi}} \qquad \text{(Equation 3)}$$

where: NSV_{ni} = net social value of a province's forest resources in year i to the nation as a whole,

VA_{pi} = total value added from the forestry sector in the province in year i,

GE_{pi} = net provincial government expenditure to maintain the forest resource base in the province in year i,

GE_{fi} = federal government expenditure to maintain the forest resource base in the province in year i,

FR_{pi} = provincial forest resource variable; either total industrial wood consumption in year i, AAC, or area harvested.

This equation can also be used to estimate the net social value of forest resources in more than one province in a regional aggregation. The model will provide a measure of regional net social value from a national accounting stance.

4.5.6 Summary of Net Social Value Model

This third model provides a partial measure of net social value for commercial forest resources used primarily for timber production. Value added is applied as the measure of social benefits resulting from the harvesting and processing of industrial roundwood. Government expenditures related to maintaining the forest resource base and infrastructure are used as the measure of social cost. There are several features of the model which must be recognized. First, the model does not provide a full measure of net social benefits since all benefits and costs incident on society are not included. As an example, extramarket costs and benefits, while important, are omitted. These can only be identified in the model. A full and accurate quantification of all extramarket values would be exceedingly difficult, if not impossible.

A second feature in theoretical terms is that the model does not measure net social value as either willingness-to-pay or the sum of consumer and producer surplus. Instead, an alternative approach was used where resource values are related to the socio-economic benefits created through timber harvesting and processing (ie. value-in-use). A major assumption is that society is at least partially represented by the public sector and economic activity in general.

One weakness in the model is an inability to address income leakage and income distribution in general. These points must be considered separately, however this weakness is shared by all benefit-cost models. While the model may be viewed as overly simplistic by some readers, in terms of thesis objectives, this feature is an advantage. The model uses published data for the most part, and should yield results which can be easily understood and applied by policy-makers in both provincial and federal governments. The model represents a reasonable compromise between strict economic theory and practical application.

4.6 SUMMARY OF CHAPTER 4

This chapter describes three alternative models to estimate the social value of forest resources used for commercial timber production in Canada. The first model uses government expenditures made to maintain the forest resource and related infrastructure as a proxy for value. The underlying assumption is that the level of expenditure by government equals the level of benefits or value to government.

The second model uses net income to value forest resources. This net value is calculated by deducting government expenditures relating to the forest resource from government tax revenues paid by industry during the harvesting and processing of timber. The residual income figure represents a net value of forest resources to government.

The third model takes a broader approach by developing estimates of value from the perspective of society rather than strictly government. Value added from the harvesting and processing of timber represents social benefits while government expenditures to maintain the forest resource base and related infrastructure represent social cost.

For each model, a provincial and federal/national accounting stance is possible. The models are designed to yield measures of value based on current industrial wood consumption. However, since published data bases normally have a short time lag, historic data may be required. An average value based on several years of data is recommended. Timber production, industry output, public revenues, and expenditures can vary from year to year based on market demand and factors such as interest rates, labour disruptions, government policies and exchange rates. Applying an average value should smooth out these irregular changes.

5.0 VALUE ESTIMATES OF NEWFOUNDLAND'S FOREST RESOURCES

5.1 BACKGROUND

In the previous chapter, three models were developed to provide estimates of value for Newfoundland's forest resources used in commercial production. The first model assumes the level of direct government expenditure on maintaining the forest resource and related infrastructure equals the benefits received. The second model derives a net income value equal to the direct government tax revenues and resource charges, less government expenditures for maintaining the forest resource and related infrastructure. These two models therefore yield a forest resource value incident on government, and can be used with either a provincial or federal accounting stance. The third model provides estimates which partially measure the net social value of commercial forest resources. Value added from industrial harvesting and processing is the measure of social benefit, while social costs are represented by the same government expenditures used in the other two models.

The main objectives in this chapter are to present the appropriate data necessary for each model and derive the resulting value estimates on a volume (per m^3) and area (per hectare) basis. The results will be discussed in detail in chapter 6.

5.2 FORESTRY DATA

In order to estimate values on either a volume or an area basis, supporting resource data are required (Table 18). The volume of wood production in Table 18 refers to industrial roundwood and includes pulpwood, sawlogs and, miscellaneous fibre used in panel products and marine applications. Both softwoods and hardwoods are included, however, the reader should note that the latter comprises less than one-half of one percent of the total production output.

TABLE 18

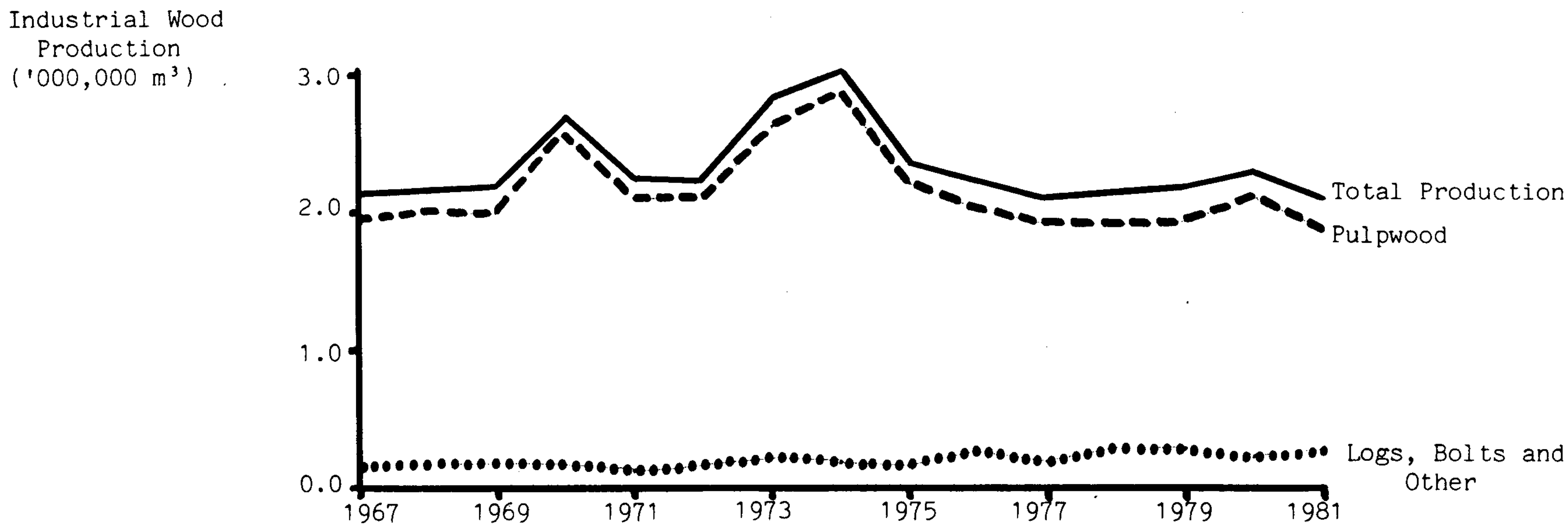
Commercial timber production and area harvested
on the Island of Newfoundland, 1967 to 1981.

Year	Production (m^3)[1]	Area Harvested (hectares)[2]
1967	2,098,000	20,173
1968	2,162,000	20,788
1969	2,168,000	20,846
1970	2,702,000	25,981
1971	2,166,000	20,827
1972	2,223,000	21,375
1973	2,810,000	27,019
1974	3,066,000	29,481
1975	2,348,000	22,577
1976	2,238,000	21,519
1977	2,112,000	20,308
1978	2,178,000	20,942
1979	2,254,000	21,673
1980	2,526,000	24,288
1981	2,127,000	20,452

[1] Source: (Statistics Canada, Catalogue 25-201)
[2] Source: Estimated by author (see text for explanation)

The figures for area harvested were calculated in the following manner. Data are available (Anon., 1981b) which provide estimates of cutover area and volume harvested for a ten year period in Newfoundland. The average volume per hectare harvested was 104 m^3. This figure, divided into the annual production data provides an estimate of the area harvested each year. The data are biased slightly in that the 104 m^3 per hectare refers only to softwoods. However, given the exceedingly small hardwood component of annual roundwood production, this bias is insignificant.

The mean annual roundwood production over the 15 year period 1967 to 1981 is 2,345,200 m^3. The trends in total production are heavily influenced by pulpwood production (Figure 8). As shown, production of logs, bolts and other miscellaneous fibre is fairly stable over the study period and makes only a minor contribution towards total production. Despite the appearance of large peaks and valleys in the total production line, the data are relatively stable.



Source: (Statistics Canada, Cat. 25-202)

Figure 8. Annual industrial wood production, Newfoundland, 1967 to 1981

The standard deviation is 285,011 m^3 and the range from 2,098,000 to 3,066,000 m^3. More importantly, the coefficient of variation is only 12.15 percent which reflects relative stability of the data over time.

For the annual allowable cut (AAC), the figure of 3.0 million m^3 (from chapter 2) will be used in the remainder of this report. This figure refers to softwood only, and since softwoods currently comprise nearly 100 percent of industrial wood production, there can be little inherent error in calculations of resource value based on AAC.

5.3 ESTIMATES OF FOREST RESOURCE VALUES

5.3.1 Model 1: Value Based on Government Expenditure

a. Summary of expenditure data

A summary of provincial and federal government expenditures is presented in Table 19 in both nominal and real values. The real values are deflated by the Implicit Price Index, Gross National Expenditure- Government Current Expenditure On Goods and Services, 1971=100 (Statistics Canada Catalogue 13-201). Provincial data include government expenditures by the Department of Forest Resources and Lands (DFRL) and contributions to specialized forestry education at the post-secondary level. The expenditures of the DFRL include administration, inventory, silviculture, protection, access road programs, forest product development; in general all aspects of forest management. Both operational expenditures (salaries and operations) and capital expenditures (vehicles, water bombers, regional office buildings etc.) are included. In addition, since Forestry was only one component of the Department, a share of the executive and support service cost (Ministers Office) must be calculated. Over the 15 year period of study, Forestry has been combined first with Mines and Agriculture (until 1973) then with Agriculture only (to present). The share of Forestry out of the executive and support service budget was estimated by assuming the ratio of this share was equivalent to the ratio of Forestry's salaries to total salaries in the Department.

Expenditures excluded from the analysis were grants to organizations such as the Newfoundland Forest Protection Association and the Maritime Lumber Bureau, contributions to Gros Morne National Park, and capital expenditures to the Labrador Linerboard mill during the mid-1970's.

TABLE 19

Summary of government forestry expenditures in Newfoundland, 1967 to 1981.

	Provincial Expenditures($)[1]		Federal Expenditures($)[2]	
Year	Nominal	Real	Nominal	Real
1967	2,932,186	3,768,877	*	*
1968	3,130,156	3,807,976	1,627,101	1,979,442
1969	2,994,845	3,364,994	1,586,728	1,782,840
1970	1,684,443	1,788,156	1,586,839	1,684,542
1971	2,889,660	2,889,660	1,606,995	1,606,995
1972	3,683,877	3,436,452	1,612,774	1,504,453
1973	4,108,096	3,529,292	2,097,507	1,801,982
1974	4,427,207	3,276,985	3,424,685	2,534,926
1975	5,651,341	3,622,654	10,248,542	6,569,578
1976	6,046,103	3,408,175	9,376,031	5,285,249
1977	6,572,030	3,378,936	10,693,493	5,497,940
1978	7,277,128	3,453,786	6,166,479	2,926,663
1979	9,879,644	4,299,236	6,338,535	2,758,283
1980	9,955,368	3,828,988	7,459,136	2,868,898
1981	12,116,558	4,098,971	11,395,326	3,854,982

[1]Source: Appendix 1
[2]Source: Appendix 2
* : No data available for 1967

The provincial government's financial contribution to professional and technical forestry education is difficult to quantify. Specific published data are not available but indirect estimates of these expenditures are possible. For professional education, Memorial University offers a one-year pre-forestry course. However, from the period 1950 to 1980, only two individuals were enrolled (1959 and 1960). Therefore the direct forestry contributions from the provincial government for this program have been minimal.

For technical education, there are two institutes which offer forestry related training: a) the College of Trades and Technology, and b) the Bay St.

George Community College. Programs include forestry technology, logging, forest fire control, forest improvement, lumber grading and sawmilling. The total number of graduates in these programs represent only three percent of total school graduates, using data from 1972 to 1980. The total cost of operating these institutions equals approximately two percent of the entire provincial government expenditure. Thus, the cost of educating the forestry related students can be indirectly estimated as 0.06 percent (3.0 percent x 2.0 percent) of the total provincial education budget. Using this approach and assuming the 0.06 percent share is constant, provincial forestry education expenditures can be estimated. Details of DFRL and education expenditures by the provincial government are shown in Appendix 1.

Federal government expenditures relating to the forest resource and infrastructure in Newfoundland comprise several elements. Research costs include federal costs of operating the Canadian Forestry Service and contributions to the ENFOR program, FORINTEK, FERIC and University forestry schools. Research costs are assigned to the Newfoundland region by dividing total national expenditure by the percentage of inventoried productive forest in the province compared to all of Canada. This method implies that federal research expenditures in other regions of the country will have some positive value to Newfoundland.

Resource related expenditures made directly within the province are also included and comprise the contributions to provincial forestry programs through Forest Subsidiary Agreements (from 1974), plus the costs of inventory work conducted prior to 1974.

Federal contributions to professional and technical forestry education in Newfoundland could not be estimated due to a lack of time-series data. From an analysis of detailed data for 1983 only, the level of federal contributions to the post-secondary forestry programs appears to be less than one-half of the provincial expenditures on forestry training, in the range of $100,000. This figure represents less than one percent of total federal expenditures on forestry research and resource programs in recent years.

b. Analysis of data

All raw data and appropriate statistical analyses are presented in Appendices 1 and 2. In real terms, the provincial government expenditures exhibit an average annual increase of slightly more than three percent per year. The real expenditures are relatively stable over time from an evaluation of relevant measures of central tendency. There is a low, negative correlation(-0.35) between wood production and expenditure, however the value of the correlation coefficient is not significantly different from zero even at the 0.20 level. The main reason for this lack of correlation is that over the period of study, wood production has remained very stable while expenditures have shown gradual real increases. A scatter diagram in Appendix 1 illustrates this point. The cluster of points rather than a definite trend line indicates low correlation and also that changes in real expenditure cannot be explained by changes in wood production.

The federal expenditure data show less stability over the period of study in comparison with the provincial data. The major cause of instability is the presence or absence of federal funding through a cost-shared Forestry Subsidiary Agreement. An initial five-year Agreement from 1974 to 1979, was not superceded by a second Agreement until 1981. Thus funding levels greatly increased after 1974, declined after 1979, and increased in 1981. For real expenditure data, the average annual increase is nearly four times greater than for provincial expenditures while the coefficient of variation is more than three times larger. The large increase in expenditures following the signing of the first Forestry Subsidiary Agreement with Newfoundland in 1974 is a major cause of the high statistical variability. The Agreement between the provincial and federal governments resulted in a massive expansion of federal funding to the forestry sector in Newfoundland. These funds, which were largely transferred to the provincial government through the Department of Forest Resources and Lands, were used to expand provincial forest management programs. From 1973 to 1974, federal forest resource contributions to Newfoundland increased from less than $700,000 to nearly $2,000,000. By 1975, these contributions were more than $8.7 million. Prior to 1974, real federal expenditures appear to be quite stable, however after the major increase in 1974, real expenditures exhibit greater fluctuation from year to year.

The correlation between real federal expenditures and industrial wood production is very poor (-0.24). Also, the correlation coefficient is not significantly different from zero even at the 0.20 level. These facts are not surprising given the greater fluctuation in expenditure while wood production remained relatively stable. A scatter diagram in Appendix 2 illustrates this poor correlation.

c. Estimates of value based on current consumption

Values per m^3 and per hectare over the period of study are calculated by dividing total government forestry expenditure each year by total annual industrial wood production and total area harvested. Both nominal and real values are calculated for the two levels of government. A graphical representation of value per m^3 of production is provided in Figures 9 and 10. The values on a per hectare basis would show similar trends given the method used for calculating area harvested from the volume of roundwood production. The graphs illustrate the greater stability of real provincial expenditures compared with real federal expenditures. As discussed previously, the higher instability of federal expenditures is due to the great fluctuation in funding through Forestry Subsidiary Agreements which were not continuous throughout the study period.

With values calculated on an annual basis, the question of what value to use in policy applications remains. Given that expenditures and to a lesser extent, production fluctuate each year, some type of average value is required. In determining the time base to use in deriving an average value, two conditions are:

1. the average should reflect recent or current trends in expenditure and production,
2. the average should smooth out small annual fluctuations in expenditure and production.

An appropriate technique to use is a moving average. These have been calculated on a three, five, seven and nine year period for the per m^3 values (Appendices 1 and 2). Of most interest are the federal data since they exhibit the least favourable measures of central tendency. For the federal

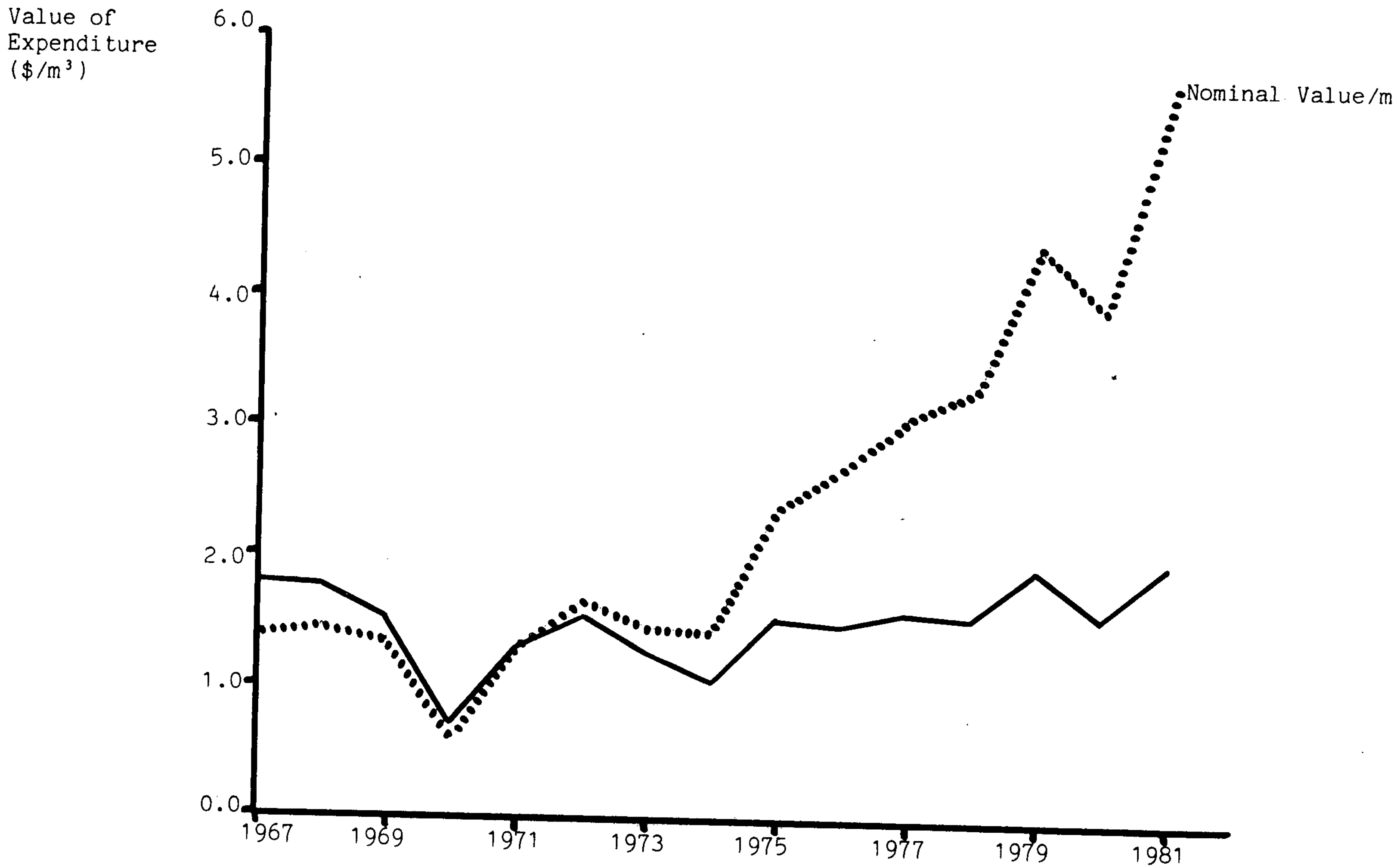


Figure 9. Provincial government expenditure per m³ production, 1967 to 1981

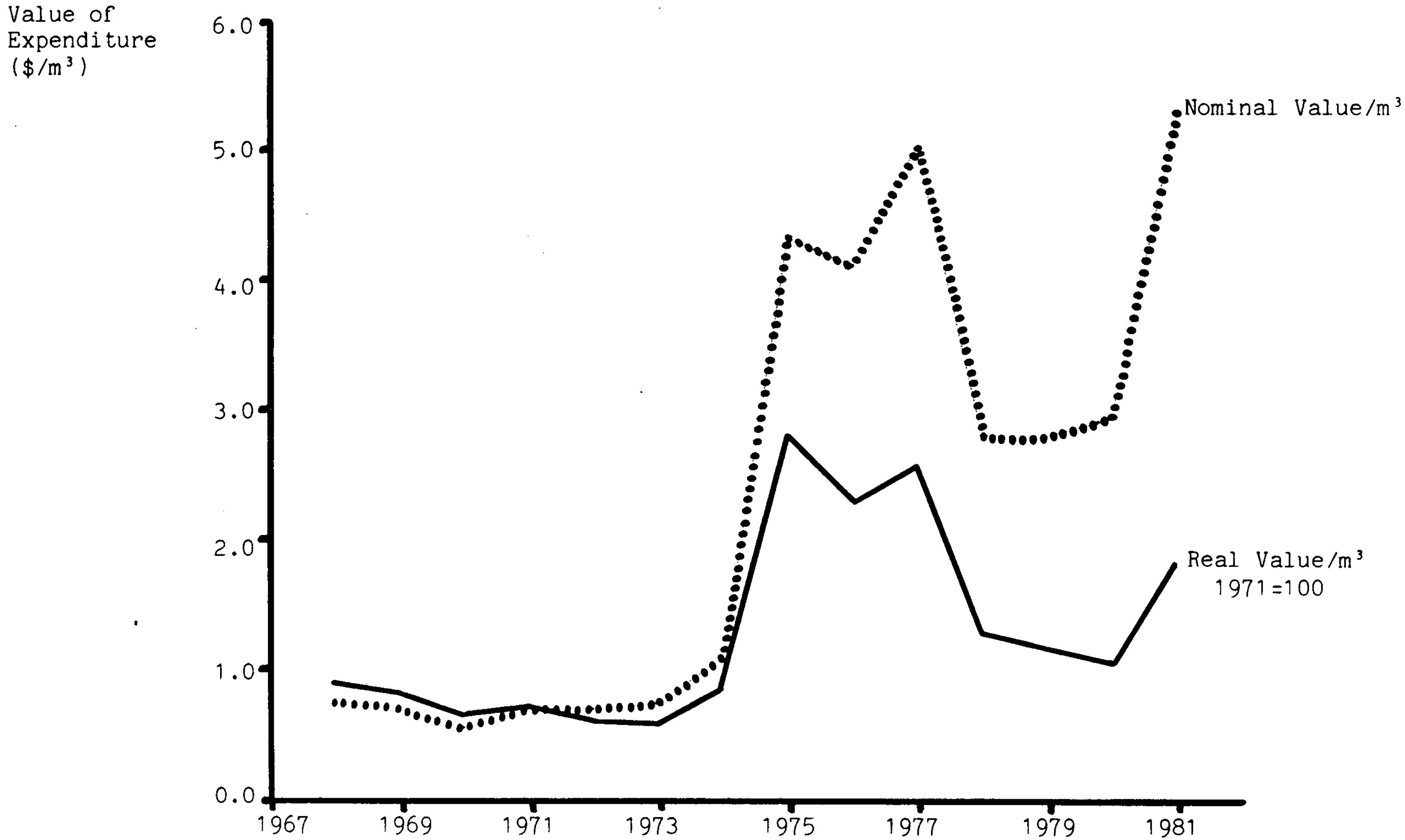


Figure 10. Federal government expenditure per m³ production, 1968 to 1981

moving average figures, the statistical characteristics improve as the averaging period increases, a fact which reflects statistical theory on sample size and measures of central tendency. However, simply to select a nine year averaging period because the statistics are better is a short-sighted approach. The average must reflect current values, which in the case of the real federal values per m^3 have been increasing from 1980. The use of a seven or nine year averaging period is therefore probably too long. While the statistics are more favourable, current trends may be masked. At the other extreme, a three year averaging period, while reflecting the most recent trends, exhibits the least favourable statistical characteristics. As a compromise, a five year moving average is suggested (Table 20).

TABLE 20

Average value per m^3 and per hectare for commercial forest resources in Newfoundland, 1977 to 1981, based on current consumption.

Level of Government	Value per m^3 ($) Nominal	Real[1]	Value per Ha. ($) Nominal	Real[1]
Provincial	4.09	1.71	425.86	177.55
Federal	3.80	1.60	395.55	168.87

[1] 1971 = 100

At this point, it would be appropriate to review what these estimates of value represent. The values reflect the average level of government expenditure associated with current consumption of industrial roundwood in Newfoundland. From the theory developed for this model, the level of government expenditure on the forest resource and related infrastructure is equivalent to the level of benefits received from harvesting and processing of timber.

d. **Estimates of value based on AAC**

A value estimate of commercial forest based on AAC should provide a measure of potential value from harvesting the full AAC of 3.0 million m^3 versus the current consumption of 2.2 million m^3 (5-year average 1977 to 1981). An implicit assumption is that total government expenditure will increase as roundwood production expands to the AAC limit. However, from the statistical analyses in Appendices 1 and 2, there is a very low correlation between government expenditure and wood production. Therefore, one cannot predict levels of expenditure associated with increased wood production. The AAC of 3.0 million m^3 lies within the range of wood production experienced over the period of study. In addition, factors such as the continuation of federal funding, provincial policies regarding forest management programs etc., can greatly influence the level of expenditure by governments. Therefore, the value estimates for an AAC of 3.0 million may not differ significantly from those derived from the period 1977 to 1981 based on current consumptions.

5.3.2 Model 2: Value Based On Net Government Income

a. **Summary of data**

A summary of net income data (Table 21), provides both nominal and real values. The data are compiled by deducting forestry related government expenditures (those in Model 1) from government revenues derived from the forestry sector. Real values are calculated by applying the Implicit Price Index, G.N.E. - Government Current Expenditure On Goods and Services (1971 = 100) to nominal government revenue and expenditure data. Provincial government public revenues from forestry in Newfoundland include corporate income tax, retail sales tax, fuel taxes and the forest management tax. Also, revenue from sawmill licences, timber rentals, stumpage and cutting permits is added. These tax and non-tax public revenues were described in the previous chapter. Deriving estimates of tax revenues is difficult due to the lack of direct data and the many assumptions required. For provincial government forestry tax revenues, detailed calculations and assumptions are provided in Appendix 3 and only a general description of methods used to estimate these taxes will be provided here.

TABLE 21

Summary of net government income from forestry, Newfoundland, 1967 to 1981.

Year	Provincial Net Income($)[1]		Federal Net Income($)[2]	
	Nominal	Real	Nominal	Real
1967	- 826,300	-1,062,100	*	*
1968	- 562,400	- 684,200	- 774,500	- 942,200
1969	- 78,800	- 88,500	- 590,800	- 663,800
1970	1,632,900	1,733,400	- 399,900	- 424,500
1971	713,800	713,800	- 503,700	- 503,700
1972	542,700	506,300	- 511,000	- 476,700
1973	913,600	784,900	- 554,000	- 475,900
1974	4,531,200	3,354,000	4,147,000	3,069,600
1975	4,499,200	2,884,100	-4,946,700	-3,171,000
1976	4,796,900	2,704,000	-8,698,900	-4,903,600
1977	6,900,900	3,548,000	-6,937,000	-3,566,600
1978	10,601,700	5,031,700	3,972,100	1,885,200
1979	11,389,100	4,956,100	6,656,500	2,896,600
1980	15,580,300	5,992,400	7,397,500	2,845,200
1981	15,326,100	5,184,700	3,632,500	1,228,900

[1]Source: Appendix 3
[2]Source: Appendix 4
* : No expenditure data available

Corporate income tax paid by the Newfoundland forest industry is estimated by applying the tax rate to published data on taxable corporate income. Where data were confidential or otherwise unavailable, indirect estimates of tax paid in Newfoundland were made by evaluating trends in published data on total corporate income tax paid by forestry in Canada.

For retail sales tax paid by the forest industry, indirect estimates are necessary using published data on the total retail sales tax collected from all sources. First, an estimate of the percentage of total retail sales tax paid by businesses versus individuals is derived from data on personal expenditure. The results, based on data for the years 1969, 1972, 1974, 1976 and 1978 suggest that on average, 49.50 percent of all retail sales taxes in Newfoundland are paid by businesses. Second, an estimate of the percentage of business retail sales tax paid by forestry is found by an analysis of taxable pulp and paper expenditures versus total taxable expenditures by all manufacturing industries. The results, based on data for the period 1966 to 1976 indicate that on average, 14.15 percent of all retail sales tax generated by businesses is paid by forestry. Therefore, by applying the product of 14.15 percent and 49.50 percent (0.07) to total retail sales tax collected, one can estimate the share paid by forestry.

Provincial taxes on gasoline, diesel and fuel oil consumed by the forest industry are estimated by applying the appropriate tax rates per litre to fuel consumption data. In some cases, the consumption data were incomplete for the entire time period of 1967 to 1981, therefore certain data were estimated using several statistical approaches as detailed in Appendix 3.

The forest management tax is available directly from published data as are the non-tax revenues of sawmill licences, timber rentals, stumpage and cutting permits.

For federal revenues, only two major taxes are levied on the forest industry; corporate income tax and an excise tax. Details of the estimation procedures and assumptions are provided in Appendix 4. Corporate income taxes are estimated from published data on taxable income from forestry firms in the province, total taxable forest industry income in Canada, and total federal corporate income tax paid by forestry firms in Canada. The estimates of taxes paid by the Newfoundland forest industry are derived by applying the ratio of taxable forestry corporate income in Newfoundland versus Canada, to total forestry corporate income taxes paid in Canada. Where some data on taxable income were missing, indirect estimates of taxes paid were made by evaluating national trends in forestry-based corporate income tax.

The federal excise tax applies to certain expenditures on materials and supplies, building and construction materials, as well as gasoline and diesel fuels. For the tax on materials and supplies, seven percent of industry expenditures on these items are assumed to be taxed, an assumption made in other studies of forestry taxation, see for example (Reed *et al.*, 1973). The tax paid by the Newfoundland forest industry is estimated by deducting the tax portion from seven percent of expenditures on materials and supplies, the data for which are published.

The excise tax on building and construction materials is derived by assuming 50 percent of expenditure on capital and repair are taxed. This assumption is based on Reed's study in which excise taxes were calculated following a survey of industry expenditure data. One problem in the case of Newfoundland, is that for published data, the province is aggregated with New Brunswick, Nova Scotia and Prince Edward Island. To estimate capital and repair expenditures in Newfoundland, expenditures on materials and supplies by the forest industry versus the Canadian total, were applied to the Canadian total for expenditures on capital and repair, to determine Newfoundland's share. The implicit assumption is that Newfoundland's share of national expenditure on material and supplies equals its share of national expenditure on forestry capital and repair. While this assumption may have theoretical weaknesses, in the absence of specific published data for Newfoundland, indirect methods of deriving the data were necessary. Certainly, the provincial share of national forestry expenditure on materials nad supplies reflects to some extent the size of the Newfoundland forest industry compared to the Canadian total, and ultimately the share of total capital and repair expenditure. The assumption regarding the relationship between expenditures on materials and supplies, and capital and repair can be empirically tested. Using published data for forestry processing from 1970 to 1982, the correlation between these two types of expenditure is strongly positive. An analysis indicates a correlation coefficient of 0.95, and a coefficient of determination of 0.89. The r value is significantly different from zero at the 0.001 level of significance using the t-test. Therefore the derived data used to estimate the excise tax on building and construction materials may be viewed with a high degree of confidence.

The federal excise tax on gasoline and diesel fuel is estimated by applying a tax rate per litre to the industry's fuel consumption. The tax rates per litre are derived by applying the percentage rate of the tax to 50 percent of the retail selling price less provincial taxes. This procedure is required since the tax is based on manufacturer's selling price. The figure of 50 percent is assumed to represent on average, the increase in price from manufacturing to the retail level and accounts for shipping costs, storage, dealer overheads and profit (Canadian Petroleum Association, 1985).

For both provincial and federal government tax revenue estimates, the reader should be aware of the many assumptions used in estimation and the sensitivity of the estimates to changes in the assumptions. In addition, the need to derive certain portions of the data base where information was not available means that the resulting tax values must be recognized as best estimates only.

b. Analysis of data

In real terms, the provincial net income from forestry shows a general increasing trend over the period of study, rising an average of 2.03 percent annually. From 1967 to 1969, provincial net income was negative, indicating that government expenditures on the forest resource and related infrastructure exceeded public revenues from the forest industry. In nominal terms, the net income figures increased by an average of 2.20 percent annually. The calculation of annual percentage change is greatly affected by the major increase in net income from a negative value in 1969 to a large positive value in 1970.

The major component of gross provincial government income is tax revenues. Of these, retail sales tax is the most important, accounting for between 61 and 93 percent of total tax revenues over the study period. The non-tax revenues such as stumpage and cutting permits make only a very small contribution to total gross income.

In real terms, net income has little correlation with industrial wood production (r = 0.12). This low correlation can be explained by two factors. First, as was shown in the first model, there is a very low correlation between real provincial government expenditures and wood production (r = −0.35). Since net income includes these expenditures, one can expect correlation to be affected adversely. Second, while one may intuitively expect public revenues to be closely related to changes in production, the exogenous impact of government taxation policy can greatly affect the level of taxes paid. In Newfoundland, tax rates have generally increased over the period of study, especially the rate of retail sales tax which is the largest component of forestry generated public revenues. Thus, a situation is possible where increasing tax rates can in fact cause increased tax revenues even when wood production and processing decline. In summary, one cannot explain changes in real net income by changes in wood production. The low correlation is illustrated by a scatter diagram in Appendix 3.

The federal net income data exhibit wide swings in value throughout the period of study. Also, for the 14 years examined, net income was negative in nine and positive in six. The data, however, tend to show greater relative stability overall than for provincial net income. This stability is explained by examining the real net income data. From 1968 to 1973, real net income is negative with a gradual trend toward zero. Following a wide fluctuation to a large positive value in 1974, there are then three years of negative but fairly stable values. In 1978, the real net income changes to a large positive value, followed by three more years of fairly stable values. Thus, the data show periods of relative stability, interrupted by occasional, albeit wide swings in either a positive or negative direction.

Excise taxes generally increased over the period of study, while corporate income taxes tended to fluctuate from year to year in response to changes in corporate taxable income. Federal tax rates were more stable than provincial tax rates over the study period. This factor contributes to the greater relative stability of real federal net income over time. While there is a low correlation between reál federal net income and industrial wood production ($r = 0.35$) the value is far better than for real provincial net income. This improvement in correlation can be explained by the greater stability in federal tax rates over the period of study. However, the inclusion of real federal expenditures in deriving real net federal income likely hinders a stronger correlation. As shown in Model 1, real federal expenditures had a low correlation with wood production. This low correlation is illustrated by a scatter diagram in Appendix 3.

c. Estimates of value based on current consumption

Value per m^3 and per hectare are calculated by dividing total net income each year by the corresponding figures for industrial wood production and area harvested. These values, calculated in nominal and real terms for both levels of government, are provided for the study period in Appendices 3 and 4. Graphical representations (Figures 11 and 12) illustrate the underlying trends for real and nominal values per m^3. In both provincial and federal graphs, real and nominal net income per m^3 are nearly equal and parallel until 1974. Following this date, the divergence between real and nominal net income lines increases due to several factors including major increases in

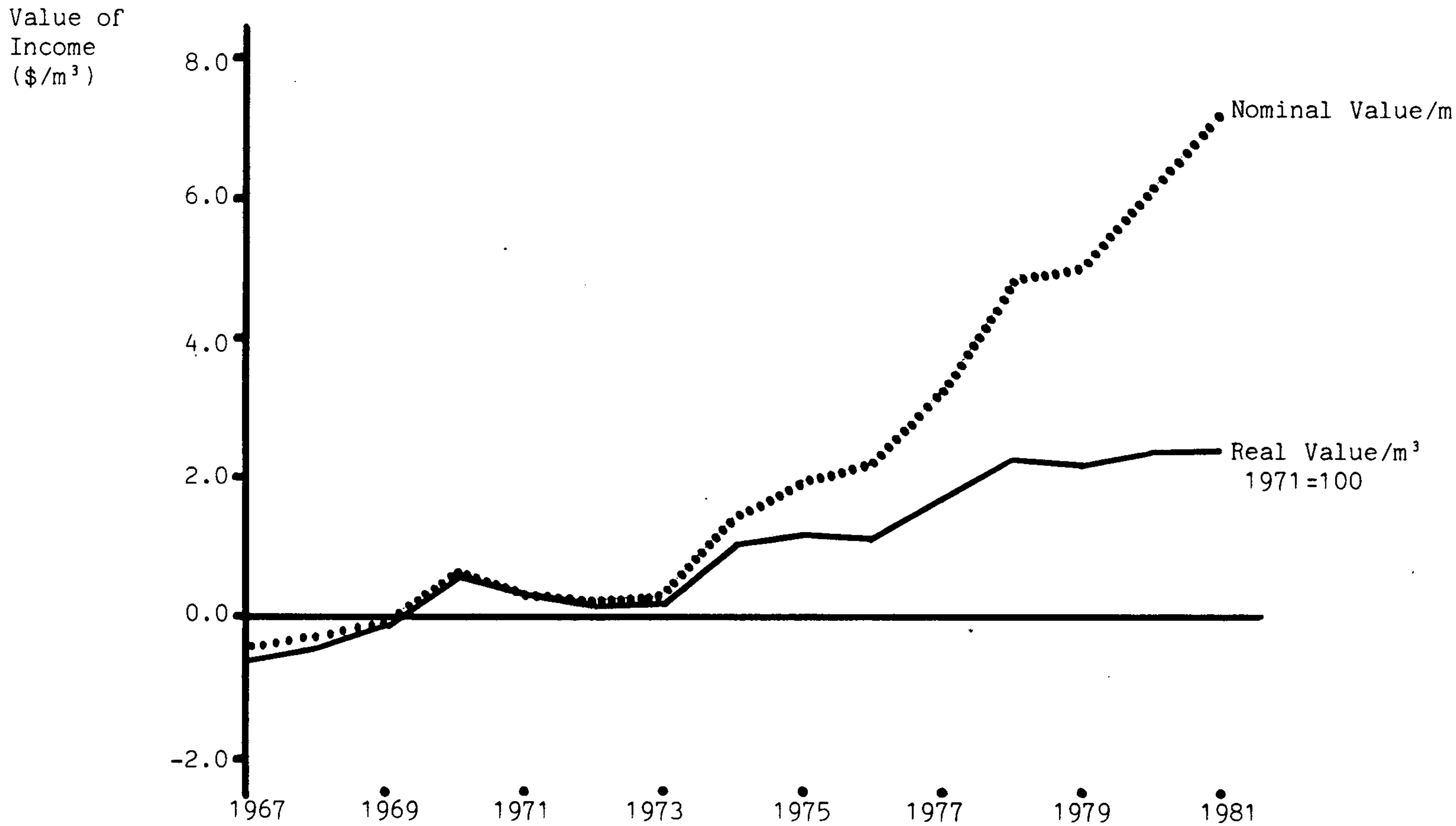


Figure 11. Provincial government net income per m^3 production, 1967 to 1981

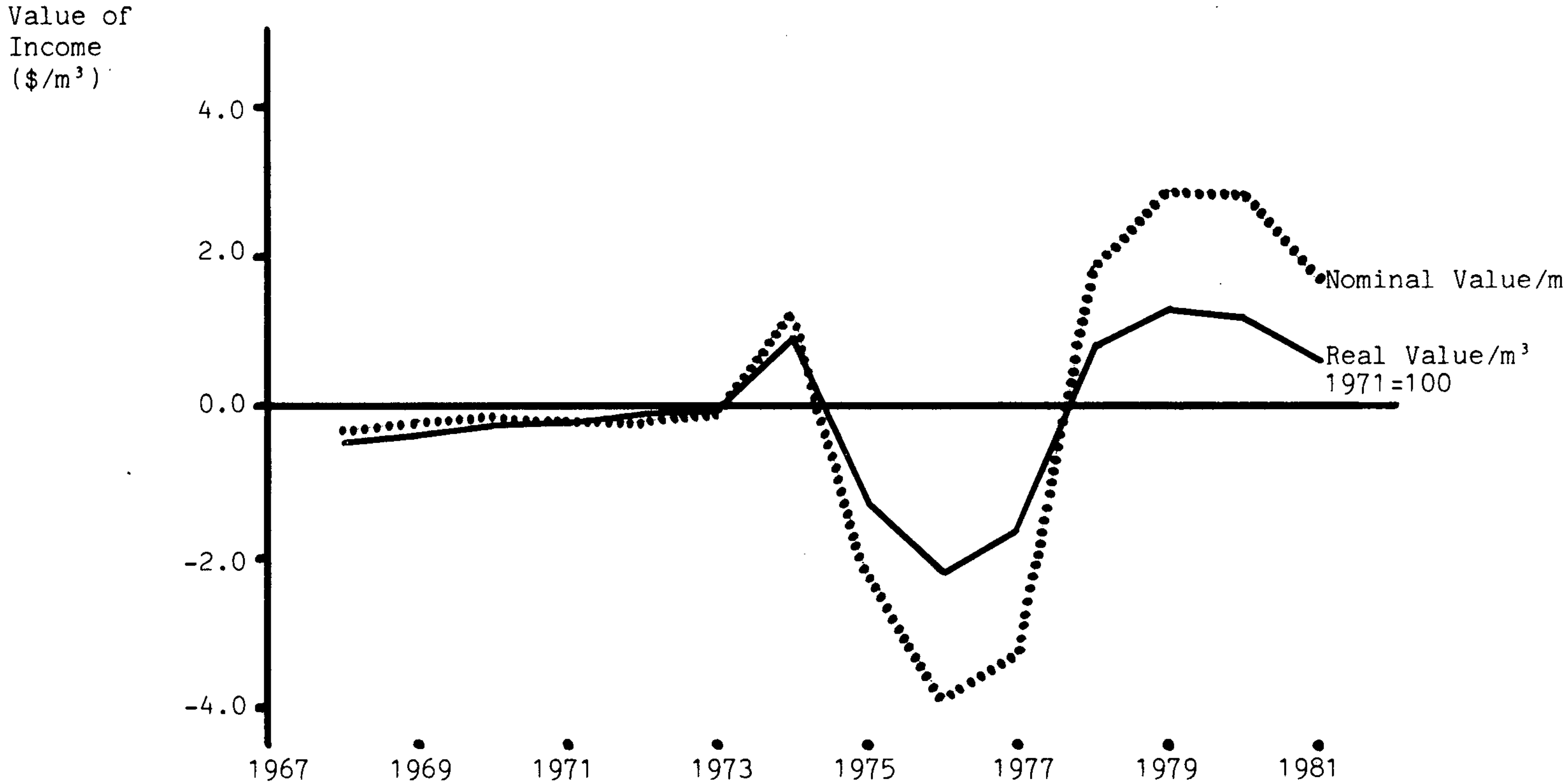


Figure 12. Federal government net income per m³ production, 1968 to 1981

corporate income tax and the level of inflation. This divergence is far more noticeable for provincial government net income.

To derive final values for use in policy applications, a five year average is calculated (Table 22) for the last five year period 1977 to 1981. As the reader may recall, a five year moving average was used in the first model following on an analysis of four alternative base years. In this way, results are consistent with those of the first model and can be directly compared if desired.

TABLE 22

Average value per m^3 and per hectare for commercial forest resources in Newfoundland, 1977 to 1981, based on current consumption.

Level Of Government	Value Per m^3 ($) Nominal	Real[1]	Value Per Ha. ($) Nominal	Real[1]
Provincial	5.31	2.20	552.48	228.78
Federal	1.23	0.44	127.48	45.05

[1] 1971 = 100

These data represent the net income value to government of forests used in commercial production. Gross income is represented by certain tax and non-tax public revenues paid by the forest industry in the course of harvesting and processing the timber resource. Net income is calculated by deducting government expenditures for maintaining the forest resource and related infrastructure. The data in this second model therefore provide an alternative measure of forest resource value based on current consumption of commercial timber.

d. Estimates of value based on AAC

Value estimates based on AAC can indicate the potential value from increasing the scale of harvesting and processing from current levels to the full AAC figure of 3.0 million m^3. To assume that net income will increase in relation to an increase in wood production requires the existence of a strong correlation between these two variables. Intuitively, one would expect gross government income through public revenues to increase in response to expanded production. However, as indicated in Appendices 3 and 4, the correlation between real net government income and industrial wood production in Newfoundland is very low. There are several reasons for this situation. First, from a comparison of coefficients of variation, industrial wood production is far more stable over the study period than real government forestry revenue and expenditure. Thus, while industrial wood production was relatively stable within a narrow range, both real government forestry revenue and expenditure experienced greater change. A scatter diagram comparing real net government income with industrial wood production (Appendices 3 and 4), illustrates the lack of any consistent trend-line. A second factor to consider is the exogenous effect of government policies related to tax rates, exemptions, and indeed the introduction or elimination of taxes. Over the study period, virtually every provincial tax related to the forest industry consistently increased. For federal taxes, this trend was less evident in that the excise tax rates declined. Nonethless, the overall conclusion is that tax rates generally are insensitive to economic conditions as reflected by industry output and hence wood consumption. Even a cursory evaluation of provincial tax data (Appendix 3), shows that every year, forestry tax revenues increased from the preceding year, regardless of industry production and output. In conclusion, the effect on net government income, especially for the province, as industry expands output to capture the full AAC in Newfoundland, is uncertain.

5.3.3 Model 3: Value Based on Net Social Value

a. Summary of data

Net social value for forestry is shown in both nominal and real terms in Table 23. The net figures are calculated by deducting government expenditures in forestry (from Model 1), from forest industry value added. For the provincial accounting stance, only provincial government expenditures are deducted. For the national accounting stance, both provincial and federal government forestry expenditures are subtracted. Real industry value added is calculated by applying the Implicit Price Index, Gross National Expenditure (1971 = 100) to nominal value added data which are published (Statistics Canada, Cat.

25-202). Deducting real government forestry expenditures from real value added results in net value added, or net social value as defined by this model.

TABLE 23

Summary of net social value from forestry, Newfoundland, 1967 to 1981.

	Provincial Accounting Stance ($000)[1]		National Accounting Stance ($000)[2]	
Year	Nominal	Real	Nominal	Real
1967	55,418.8	64,160.1	*	*
1968	48,597.8	54,510.0	46,970.7	52,530.6
1969	52,102.2	56,135.0	50,515.4	54,352.2
1970	59,265.6	61,111.8	57,678.7	59,427.3
1971	50,556.3	50,556.3	48,949.3	48,949.3
1972	56,265.1	53,657.8	54,652.3	52,153.4
1973	83,676.9	73,071.9	81,579.4	71,269.9
1974	142,175.8	107,702.0	138,751.1	105,167.1
1975	109,999.7	75,427.9	99,751.1	68,858.4
1976	105,151.9	65,917.2	95,776.9	60,632.0
1977	139,475.0	81,834.2	128,781.5	75,886.3
1978	177,741.9	97,209.4	171,575.4	94,282.8
1979	197,493.4	98,006.2	191,154.8	95,247.9
1980	205,144.6	91,432.3	197.685.5	88,563.4
1981	242,479.4	97,861.8	231,084.1	94,006.8

[1]Source:Appendix 5
[2]Source:Appendix 6
* :No expenditure data available

At this point, some consideration of the data used to derive the values in Table 23 is warranted. In the previous chapter, a brief discussion on value added in general was provided, without reference to specific data and data sources. Statistics Canada publishes two separate time series data sets for value added by industry groups. The first data set is value added based on production, defined as value of shipments of own manufacture plus net change in inventory of goods in process and finished goods, less material and supplies, and fuel and electricity used (Anon., 1981c). The second data set is value added based on total activity, defined as value added from production plus value added from non-production. The latter includes value added from product rentals, and depreciable fixed assets produced by the work force for own use. Also included are incomes earned by employees not engaged directly in production such as working owners and partners, sales, and distribution personnel. With specific reference to forestry, non- production employment incomes earned in the wood processing sectors includes loggers' incomes reported separately under the primary sector data. By using total activity data for value added, some double counting between harvesting and processing is possible. Therefore, this study uses value added based on production only. A secondary reason for adopting this approach is the focus of the study upon resource values based on the production (harvesting and processing) of commercial timber.

An additional point to discuss is the relationship between the net social value estimates derived in Model 3, and the broader concepts of GDP at factor cost and market prices. In Canada, Statistics Canada publishes national income data (Cat. 13-201, 61-208) for each province and the country as a whole. Using Newfoundland as an example, these data show total provincial GDP over time. Provincial GDP at market prices less indirect taxes (net of subsidies) which affect market prices, equals net provincial GDP at factor cost. This macro-GDP figure includes income from all sources, for both industry and government. Thus, gross incomes earned by industries, industry employees and government employees comprise a portion of the GDP figure calculated by Statistics Canada.

At the industry level only, Statistics Canada calculates the contribution to provincial GDP at factor cost by deducting indirect taxes (net of subsidies) from total value added for the industry. As the reader will recall, industry value added is calculated by deducting from net market price, the cost of purchase inputs used in the production process such as materials and supplies.

There are two points to recognize. First, value added by industry sector does not equal the industry sector's contribution to provincial GDP at factor cost even though both are published by Statistics Canada. The value added figures (both on production and total activity) generally are greater than the corresponding figure for GDP at factor cost. The difference is that value added includes indirect taxes and subsidies which affect market prices.

Second, the broad provincial or national macro-GDP at factor cost statistics include some government expenditures, notably for government employee incomes. However, expenditures aside from government employees, such as funding forest management, are not included in these Statistics Canada data. In this study, government expenditures relating to forestry are viewed as a measure of social cost. Therefore, one cannot directly compare the net social value estimates in this study with the broader macro-GDP statistics.

These two points are presented to indicate that the estimates of net social value in this study have a conceptual linkage to Statistics Canada GDP statistics insofar as value added is a common variable. However, the inclusion of government expenditures as the measure of social cost means that the net value estimates cannot be compared directly with national income accounts for a particular province or Canada as a whole. The reader should note that developing estimates of industry GDP at factor cost is not the goal of this study, nor this model in particular. The main objective here is to develop a measure of net social value from the harvesting and processing of timber which has value added as one component.

b. Analysis of data

For values derived under a provincial accounting stance, both the real and nominal data exhibit generally rising trends over the period of study, 1967 to 1981. The average annual percentage increase for nominal values is nearly three times the rate for real values, indicating that much of the nominal gain in net social value over time is due to inflation. The coefficient of variation is nearly 26 percent, thus indicating high fluctuation of values around the mean. The major change in net social value under a provincial accounting stance occurred in 1974, due mainly to the output of the ill-fated Labrador Linerboard mill. This mill only operated from 1973 to 1977, with peak production in 1974.

Values derived under a national accounting stance exhibit similar trends and statistical characteristics to those under the provincial accounting stance. The annual average percentage increases are slightly higher, as is the coefficient of variation. Both real and nominal data sets show generally rising trends over the period of study, 1968 to 1981. Due to the lack of federal expenditure data for 1967, this year had to be omitted from the analysis.

Of particular interest is the fact that under both accounting stances the identical correlation coefficient and r^2 resulted when a regression was constructed between real net social value and industrial wood production. The low r value (0.33) indicates a poor correlation between these variables. As well, the r^2 of 0.11 means that one cannot predict the change in real net social value resulting from a change in industrial wood production. An obvious inference is that by including real government expenditures into the analyses, the net social value data gain increased variability. The question arises; is real value added by itself strongly correlated to wood production ? The answer is **No**. A simple regression between these two variables yields a coefficient of correlation of 0.32, which is nearly identical to the coefficient obtained using real net social value.

Clearly, changes in value added are influenced by factors other than a change in wood production itself. As discussed briefly in the previous chapter, there are two main factors which can influence value added as calculated by Statistics Canada on an industry basis. The residual approach used means that changes in product price and/or costs of purchased materials and supplies, and fuel and electricity, will ultimately change the level of the residual, or value added. While unrelated to the main objectives of this study, these results suggest that further research is possible into the causes of change in value added. One approach to explore would be to develop an econometric model to predict changes in value added using a multiple regression with several independent variables.

For both the provincial and national accounting stances, background data and statistical analyses are provided in Appendices 5 and 6.

c. Estimates of value based on current consumption

Estimates of net social value based on current consumption are made in the same manner as for the first two models. Values per m^3 and per hectare are derived by dividing net social value each year by the corresponding figures for industrial wood production and area harvested. Values are calculated for both the provincial and national accounting stances over the period of study to 1981 (Appendices 5 and 6). To better evaluate trends in net social value per m^3 over time, graphs are provided (Figures 13 and 14). For both accounting stances, upward trends in net social value are evident, moderate in the case of real values and more pronounced for nominal values. The increasing divergence between real and nominal values reflects higher levels of inflation experienced from the mid-1970's.

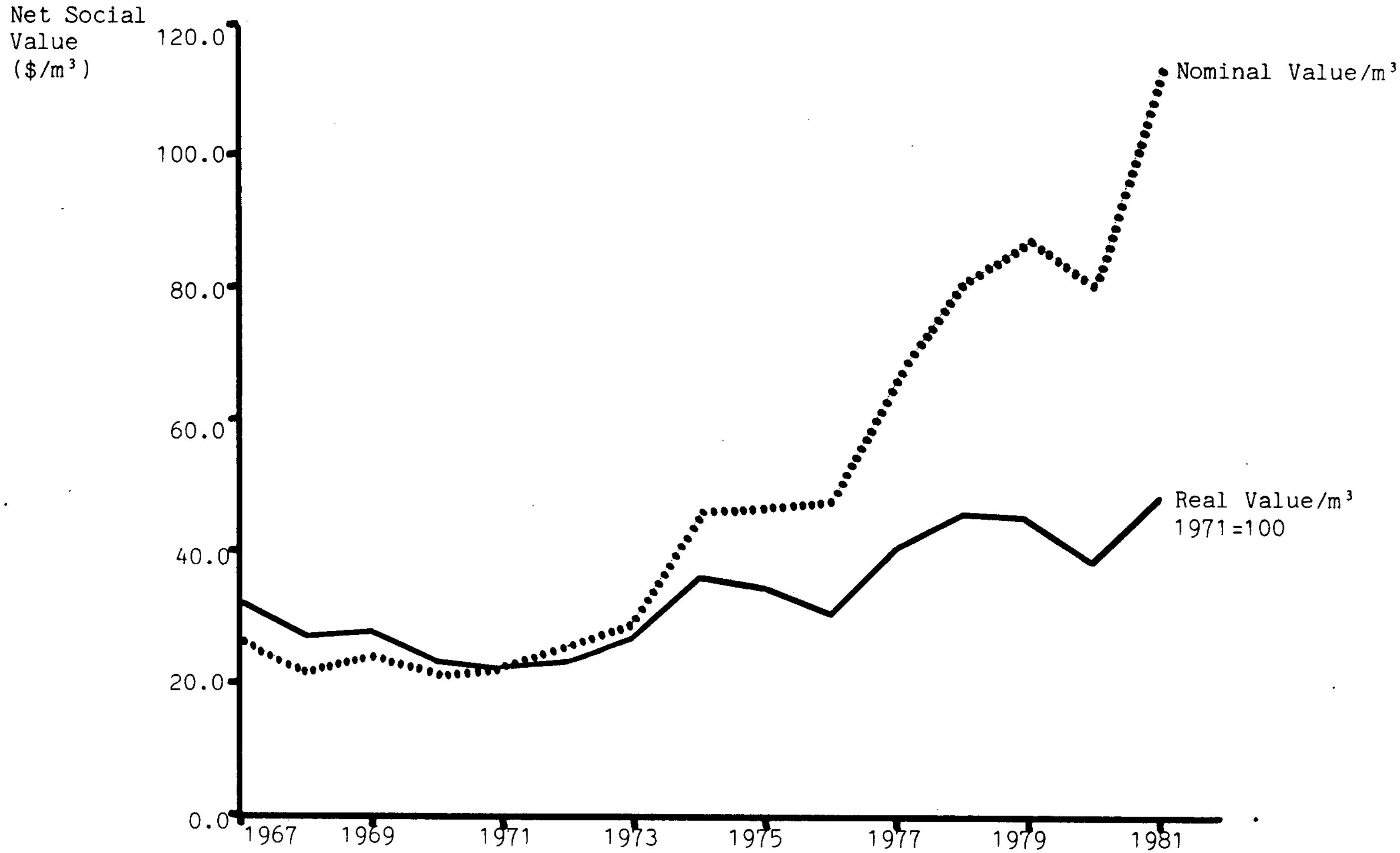


Figure 13. Net social value per m³, provincial accounting stance, 1967 to 1981

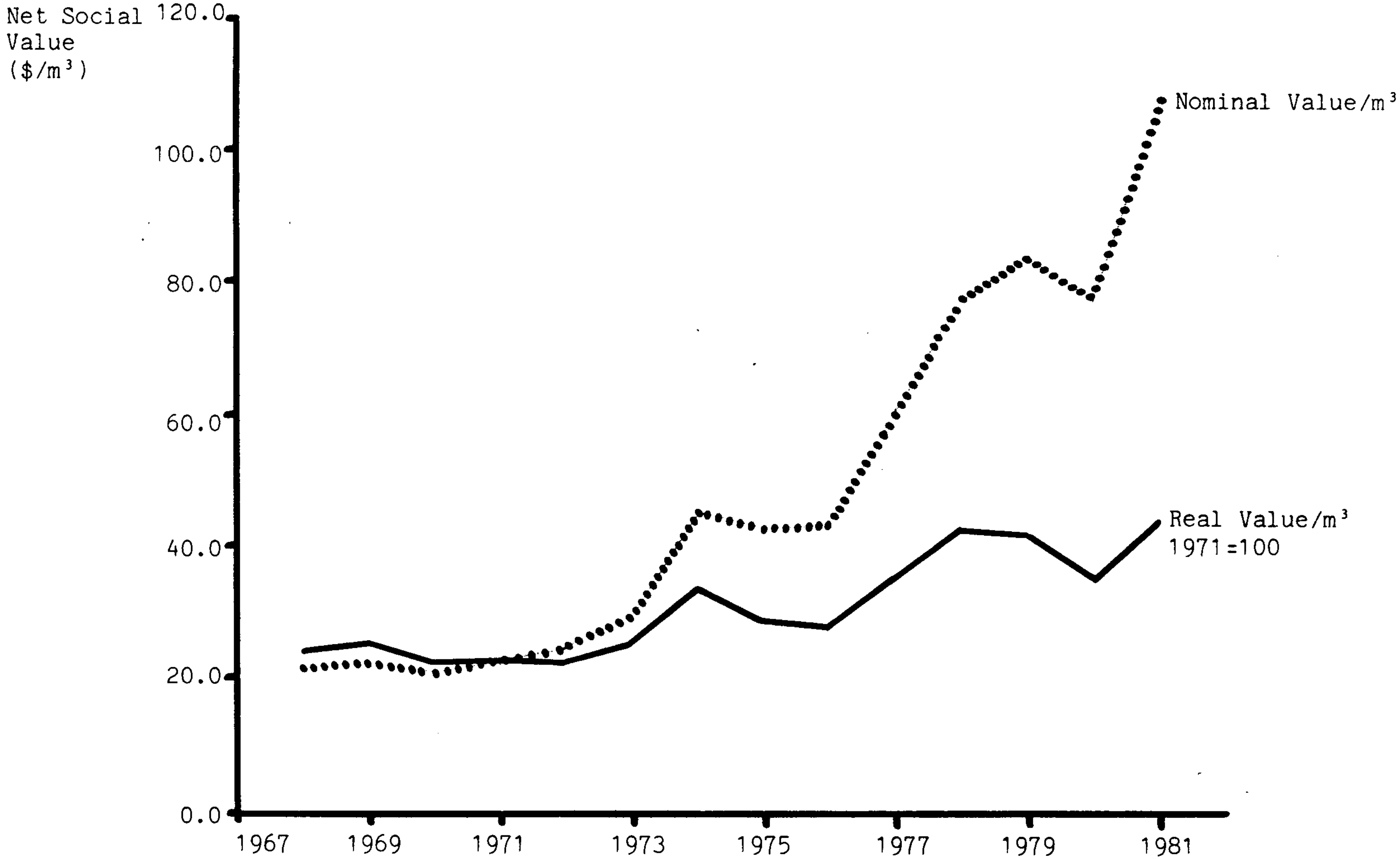


Figure 14. Net social value per m³, national accounting stance, 1968 to 1981

To derive net social values for use in policy and economic analysis, a five-year average is calculated for the period 1977 to 1981 (Table 24). Therefore the results in this model can be directly compared with results from the first two models.

TABLE 24

Average value per m^3 and per hectare for commercial forest resources in Newfoundland, 1977 to 1981, based on current consumption.

Accounting Stance	Value per m^3 ($) Nominal	Real[1]	Value Per Ha. ($) Nominal	Real[1]
Provincial	86.10	43.48	8954.02	4521.71
National	82.29	40.15	8558.47	4175.30

[1]1971 = 100

These values exhibit two characteristics of interest. First, the net social values for the two accounting stances show little difference. The provincial values are only 4.6 percent greater in nominal terms (8.3 percent in real terms) than those under a national accounting stance. Clearly, the addition of federal forestry expenditures to provincial expenditures has only a minor impact on net social value under a broader accounting stance. Second, nearly one-half of the nominal values can be attributed to inflation since the base year of 1971.

The values in Table 24 provide a partial estimate of net social value of commercial forest resources in Newfoundland. The values are based on the flow of socio-economic benefits from harvesting and processing timber (measured by value added), less public costs of maintaining the forest resource base and related infrastructure (measured by government forestry expenditure).

d. Estimates of value based on AAC

Given the poor correlation between net social value and industrial wood production, one cannot use a simple regression to predict the net social value of forest resources in Newfoundland resulting from the harvesting and processing of the full AAC of 3.0 million m^3 instead of current production levels. While government expenditures can fluctuate each year, regardless of production levels and thus influence social cost measures, value added itself is poorly correlated with industrial wood production.

5.4 SUMMARY OF CHAPTER 5

In this chapter, estimates of forest resource values were derived for the three models developed in chapter 4. The first model equates resource values with the level of government expenditure made each year for maintaining the resource base, including related infrastructure. The second model estimates the net income value of forest resources to government by deducting these same government expenditures from public revenues (taxes, royalties etc.) paid by the forest industry. For each of these models, values were derived for both the provincial and federal governments.

The third model provides estimates of resource value to society as a whole rather than strictly to government. Two accounting stances were used, first on a provincial basis, and second, on a broader national scale. Value added by the forest industry is used as the measure of social benefit while government expenditure on forestry from the first two models is the measure of social cost.

For each model, resource values were calculated on a per m^3 and per hectare basis from annual production of industrial roundwood and the corresponding area harvested. In this study, these values are defined as being based on current production and consumption of roundwood by the forest industry. In each model, values were derived from the last five-year period (1977 to 1981), based on a five-year moving average approach.

Resource values based on the potential harvest of the full AAC rather than current consumption could not be estimated for all three models. The primary cause was the lack of correlation between total value (or net value) as defined by each model, and industrial wood production. The major reasons for this poor statistical relationship were relatively stable production over the study period and the influence of exogenous factors upon the measures of value.

6.0 DISCUSSION OF RESULTS

6.1 BACKGROUND

As a background to this chapter, a summary of resource values derived in chapter 5 is provided (Table 25).

TABLE 25

Forest resource values per m^3 and ha., Newfoundland, average for 1977 to 1981.

Model 1: Expenditure Value to Government

Level of Government	Value Per m^3 ($) Nominal	Value Per m^3 ($) Real	Value Per Ha. ($) Nominal	Value Per Ha. ($) Real
Provincial	4.09	1.71	425.86	177.55
Federal	3.80	1.62	395.55	168.87

Model 2: Net Income Value to Government

Level of Government	Value Per m^3 ($) Nominal	Value Per m^3 ($) Real	Value Per Ha. ($) Nominal	Value Per Ha. ($) Real
Provincial	5.31	2.20	552.48	228.78
Federal	1.23	0.44	127.48	45.05

Model 3: Net Social Value

Accounting Stance	Value Per m^3 ($) Nominal	Value Per m^3 ($) Real	Value Per Ha. ($) Nominal	Value Per Ha. ($) Real
Provincial	86.10	43.48	8954.02	4521.71
National	82.29	40.15	8558.47	4175.30

The reader should note that the values are not directly comparable since each model uses different data and assumptions. Also, all values are based on the current consumption of forest resources rather than the total growing stock as measured by AAC. Finally, one should note that the first two models refer to value to government while the third model refers to the broader economic concept of net value to society. However, while it is difficult to compare directly the values in Table 25, one can discuss the relative strengths and weaknesses of each model in general. The objective of this exercise is ultimately to select the best model(s) for use in policy development and economic analysis.

6.2 MODEL COMPARISON

To compare the three models in terms of strengths and weaknesses requires the use of different criteria. There are four criteria which are suitable for comparing these models; 1. theoretical 2. practical 3. statistical and 4. applicability to policy and analysis needs. While other criteria may exist, these four are sufficient to evaluate and compare the models in this study.

1. Theoretical

Criteria under this heading relate to the nature of values produced by each model. As discussed in chapter 3, a concept was developed which defined value in terms of a continuum. The optimum measure of value was net social benefit in which all costs and benefits incident upon society are quantified. As one moves away from this optimum point, other values are identified such as those determined by market trading, or by government regulation and administration. As shown in chapter 4, each of the three models yields some measure of value consistent with the theory developed in chapter 3. Clearly, the third model (net social value) provides the best estimate of value of the three models. Although the estimates are only partial measures of net social benefits, they are superior to values yielded by the first two models, since these yield values incident solely upon government rather than a broader concept of society. The first model uses only costs, represented by government forestry expenditures, as the measure of benefits received from harvesting and processing timber. Certainly, these expenditures may be of long-term benefit to both government and society insofar as they help to maintain the stock of forest resources. However, in the short-term, industry can continue to harvest and process timber to society's benefit even if these government expenditures are reduced or even eliminated. The linkage between expenditure and short-term economic benefits is weak. Also, the first model loses some theoretical justification in that no actual measure of benefits (as opposed to costs) is used.

The second model is an improvement over the first in that a net value is ultimately derived. The main theoretical weakness is that like the first model, the resource values are incident solely upon government. From the theory of a value continuum developed in chapter 3, values based more on the concept of society rather than one component such as government, are closer to the optimum of net social benefits. Therefore, the third model is favoured in terms of theoretical criteria related to value.

2. Practical

Practical criteria refer to the availability of data required to make the value estimates in each model, the ease of estimation, the assumptions required and resulting accuracy of the values produced.

Each of the three models requires a mix of data, available directly from published statistics and estimated indirectly from various published sources. The government expenditure data are important in this study, forming the sole measure of value in the first model, and representing a measure of cost in the other two models. The majority of expenditure data are available directly from published statistics or various government sources. Only the education expenditures in the provincial side of Model 1 were indirectly estimated from published data. Therefore, the process of deriving value estimates for the first model, or calculating total costs for the other two models is a relatively simple exercise. Insofar as most of the data are easily obtained from published sources, the accuracy of the estimates are thought to be good. However, one should recall that not all government department expenditures relating to forestry were quantified, only those from the provincial and federal "forestry departments". Thus, the expenditures used in the three models are underestimates. In defence however, the contribution to total government forestry expenditure, from "non-forestry" departments is thought to be small. As well, expenditure estimates could not be derived directly from public accounts data. Instead, one would have to solicit information from the individual departments concerned, a costly and time-consuming exercise with no guarantee of success. In summary, the government expenditure data used in this study are fairly representative of actual expenditures and reflect a good compromise between accuracy, data availability and ease of estimation.

The second model (net income to government) incorporates these expenditures as a proxy for cost while using public revenues to measure gross income. The main component of public revenues consists of various taxes levied on the forest industry. Generally, no published data are available which refer to the amount of tax paid by a specific industry sector such as forestry for any province. Instead, one must estimate these tax payments indirectly, using a wide range of published data. These estimates are subject to a number of assumptions which in some cases are simply drawn from similar studies in other regions. Also, some estimates of taxes are highly sensitive to changes in assumptions. There is little that can be done to alleviate this situation. Using accepted research methods and by following examples of similar studies, estimates of taxes paid by the forest industry can be derived. Assuming that full, published data are used in deriving these taxes, one can assume they represent the best possible estimates. Unfortunately for the Newfoundland region this was only partially true. As indicated in Appendices 3 and 4, certain background data had to be estimated in addition to the taxes themselves. While the methods used were sound, the fact that gaps in data bases required estimation (e.g. fuel consumption, capital and repair expenditures), means that the tax estimates lose even more accuracy. Other regions of Canada enjoy a wider range of published data because the larger scale of their forest industry allows Statistics Canada to publish more complete data. In Newfoundland, several of the required data were confidential. There is no opportunity to estimate data for Newfoundland by subtracting data for all other provinces from national totals. Statistics Canada prevents this practice by restricting data from at least two provinces. As a summary, while the public revenues derived in the second model are fair estimates, availability of data was poor, the calculations were difficult, and required many assumptions.

The third model (net social value) was the easiest for deriving estimates. On the cost side, the same government expenditures are used as with the first two models. On the benefit side, data for value added are available directly from published sources. Therefore, availability of data and ease of estimation are good and are limited only by information on government expenditures. In summary, the value estimates for Model 3 are similar to those of Model 1 in terms of meeting criteria of data availability, ease of estimating and accuracy of resulting values.

In considering all three models, the question of time lags in updating the statistical data base must also be considered. Each model requires data which, for the most part, are published by Statistics Canada. With Statistics Canada data, the usual time lag is approximately two years. As an example, data collected for the 1983 calendar year is not published until 1985 or even early 1986. Since each of the three models requires some Statistics Canada information, similar constraints are experienced in updating the five-year moving averages of forest resource values. Therefore, none of the models has any particular advantage in terms of updating. After considering all of the previous discussion relating to practical criteria, Models 1 and 3 appear equally favourable. The second model must be ranked lower.

3. Statistical

Key statistical parameters are displayed in Table 26 from real time-series data for each model.

TABLE 26

Comparison of statistical parameters.[1]

Model And Accounting Stance		Coefficient of Variation (%)	Value of r^{2*}	Annual Increase (%)
1.	Provincial	16.67	0.12	3.01
	Federal	53.90	0.06	11.68
2.	Provincial	12.44	0.02	2.06
	Federal	1079.21	0.12	0.49
3.	Provincial	25.50	0.11	4.71
	National	26.37	0.11	6.35

[1]Source: Appendices 1 to 6
* From regression of value measure with industrial wood production.

If one considers the separate accounting stances for the three models, six individual models can be evaluated. Among the provincial models, no definite trend emerges. As an example, Model 2 has the lowest coefficient of variation and annual percentage increase, yet possesses the least favourable r^2 value from the regression between the measure of value (in real terms) and industrial wood production. Model 1 has the best r^2 value and, the second most favourable coefficient of variation and annual percentage increase. Model 3 has a value of r^2 which is quite close to that in the second model, yet possesses the least favourable values for the other two statistical parameters.

Among the federal/national models, the first model has the least favourable statistical values for each parameter. Between Models 2 and 3, both have similar r^2 values. Model 2 possesses the better coefficient of variation while Model 3 has a better figure for annual percentage increase.

One approach to selecting only one model out of the six alternatives presented in Table 26 is to use a ranking system whereby the statistical characteristics are scored based on their order of superiority. First, all provincial models can be compared. For each statistical parameter, the model with the most favourable value receives a score of two. The second best value receives one, while the least favourable receives zero. The same method is then applied to the federal/national models. By summing the scores for both accounting stances in each of the three general models, a total score results. These three total scores can then be directly compared (Table 27).

From Table 27, it is clear that overall, Model 2 exhibits the most favourable statistical characteristics, taking into consideration both accounting stances. The individual statistical parameters have not been weighted. In the author's opinion, each is of equal importance, thus one parameter is not weighted more heavily than another. This approach is totally subjective and recognizes that other readers may have different views. However, even more complex systems of ranking and weighting may be no better in objectivity yet may yield similar results.

TABLE 27

Ranking of statistical parameters.

Model and Accounting Stance	Statistical Parameter and Score			Total Score
	Coefficient of Variation	Value of r^2	Annual % Increase	
1. Provincial	1	2	1	4
Federal	1	0	0	1
Sub-Total	2	2	1	5
2. Provincial	2	0	2	4
Federal	0	2	2	4
Sub-Total	2	2	4	8
3. Provincial	0	1	0	1
National	2	1	1	4
Sub-Total	2	2	1	5

4. Applicability

The criterion of applicability refers not only to the actual use of the values per m^3 or hectare in policy analysis, but also the time series data inherent with each model. In the context of policy applications, the reader should recall that the alternative models, background data and results were developed for use by government, both at the provincial and national level.

Each of the three models has advantages and limitations in terms of applicability. In the author's opinion, the data bases on their own, developed for the period 1967 to 1981, will be of extreme interest to public officials concerned with forest policy in Canada. Of more importance however, are the resource values themselves and their use in addressing various policy issues and economic analyses involving the forestry sector.

The results in Model 1 provide the least favourable measure of value as discussed earlier in this chapter. In spite of this fact, the results can still be of limited use in government policy. One application to consider is in countering claims by various individuals or groups that governments spend inadequate funds on forestry. Avoiding the issue over what is "adequate", the provincial and federal governments can use the results to illustrate recent average expenditures related to the forest resource. The results can be presented either as total expenditure, or expenditure per m^3 of wood harvest. Alternatively, the expenditure per hectare cleared through harvesting could be used. By providing information on what current levels of expenditure are, government policy makers and politicians could then consider what is an appropriate level of expenditure.

A second policy application is in the negotiation of cost-shared federal/provincial Forestry Subsidiary Agreements which currently exist in all regions of Canada. From the author's own experience with such Agreements in Newfoundland, one of the more difficult policy issues is the negotiation of the expenditure share by each level of government. The establishment of current expenditure levels would make available better information to address this issue. Other criteria of course, are also important in negotiating the cost-sharing ratios, and include the cost-sharing ratios in previous Forestry Agreements in Newfoundland, ratios for new Agreements in other provinces, the fiscal capability of each level of government, and the negotiating skill of senior bureaucrats and politicians. Nonetheless, the provision of more information, such as current levels of government forestry expenditure, should allow more effective and perhaps equitable decisions to be made in determining Agreement funding levels.

This first model ultimately lends itself to policy applications related to expenditures or funding by governments rather than valuation of forest resources. The lack of any input which measures benefits from the forest, in addition to cost or expenditure, appears to constrain policy applications related to value. This shortcoming is addressed in the second model, which estimates the net income value of commercial forests to government. By yielding results based on both expenditures and revenues, a wider range of policy applications exist. From primarily a provincial perspective, the net income values can be used in policy applications related to the forest resource itself, for example protection and silviculture. With forest protection, the net income results provide a measure of resource value which can be lost to government by failing to protect stands from fire, insects or disease. In this case, the provincial government can assess the net income values at stake in the face of an abnormally bad fire season, or a serious outbreak of destructive insects. Given a measure of value and potential loss in value to forests, protection policies can be assessed and adjusted. The net income value can also provide a guide as to what increased level of protection expenditure is possible. As an example, if the net provincial income from forestry is $552.48 per hectare, this figure might represent a maximum level of increased protection expenditure which the government can justify.

Similarly, with silviculture investments, the government may be interested in expanding the growing stock through increased expenditures on planting for example. Assuming one could predict future net income per m^3 or hectare, the discounted value would indicate the present value of net income from bare land if planted with trees. This figure can then be used as a guide in setting a limit for increased government expenditure on silviculture to expand the growing stock.

Additional policy applications from using the data base relate to comparisons between industrial sectors in one province, or among the forestry sectors in each province at the federal level. With the first example, a province can compare the total net income value between different industries. Dividing total gross income by total expenditure yields a figure which represents public revenue per dollar of government expenditure. Comparing different industry sectors would illustrate the capability for net public revenue generation. Obvious implications for government policy include investment and taxation. A government might tend to invest more public funds in an industry with a high capacity for generating public revenues. Alternatively, an industry which returns little in the way of public revenues may not be carrying its share of the provincial tax burden. At the national level, the federal government can compare the public revenue received per dollar of forestry expenditure among the ten provinces. This information would be useful in priorizing regional forestry expenditures on the basis of public revenues returned.

When considering policy applications of net income, especially those involved with interindustry or interprovincial comparisons, the implicit effect of tax rates must be recognized. The level of net income is clearly affected by tax rates. Therefore, increased net income and hence resource values per m^3 or per hectare can result from governments' raising tax rates and decreasing expenditures. This strategy is shortsighted and, in the long run, might result in a forest industry unable to generate reasonable profits and compete in world markets. Also, by reducing expenditures on maintaining the forest resource and related infrastructure, a government may ultimately cause a long-term decline in wood supply. For comparisons of net income between industries or provinces, government policy-makers must recognize that differences in net income value may be largely due to differences in tax rates. The main point here is to indicate that the net income model must be used with caution in government policy analysis.

The third model (net social value) provides values which are not incident solely upon government, but rather society as a whole, defined here as the general economy of a province or the entire nation, depending upon the accounting stance used. Society as such includes government activity at the provincial and national level. Therefore, this model should provide considerable scope for government policy analysis of the forestry sector.

Primary policy applications relate to the resource values themselves, similar to the second model. Examples include valuing the forest resource in the context of issues concerned with protection, silvicultural investments and land-use. The main difference between this and the previous model is the incidence of values, that is society as defined, versus government only. Thus, in the forest protection example, resource values threatened by fire, insects or disease represent potential losses to society (public sector and the general economy) rather than potential losses in direct revenues to government. Similarly, for analyzing silvicultural investments to increase forest growing stocks above current levels, the net values produced by this model represent potential gains to society through the eventual harvesting and processing of this incremental volume. For land-use issues between forestry and a competing sector, the government can compare the net social value per hectare. Given that value added and government expenditure are quantified in the model, this type of analysis is restricted to economic activities which ultimately yield a marketable product. Comparing commercial forestry production with recreational uses such as camping, hunting and photography would be extremely difficult.

Other policy applications include comparing net social value of forest resources between different provinces. In this case, the federal government can use the results as background information when developing investment policies and funding programs for the forestry sector in each province. For interindustry and interprovincial comparisons, government policy-makers may also be interested in assessing the share of value added among labour in the form of wages, and industry in the form of profits. The percentage of labour income from total value added for example, can be a useful measure of local employment input and hence regional economic activity.

The data base for each model could also be useful in policy analyses of the forestry sector. The time series data provide information on trends, both in nominal and real terms. This information can be applied when making forecasts of future outcomes. With the first model, forecasts of government expenditure related to maintaining the forest resource and related infrastructure can be made. Such forecasts would be useful over the short-term in government planning and budgeting. These forecasts would require the assumption of no change in government policy regarding funding of forestry programs.

With the second model, forecasts can be made for both government expenditures and public revenues relating to the forestry sector. This information is also of importance in the area of government planning and budgeting. An obvious but necessary assumption is that government policies related to forest sector taxation will remain unchanged over the forecast period.

For the third model, the trends in value added over time are useful as background information in government policy and planning. Given that value added reflects some measure of economic activity and social welfare, an obvious goal of government at both provincial and national levels would be to maintain and increase value added per m^3. This policy implies increasing the level of wood processing within a province or the nation as a whole. Thus, rather than exporting lumber or market pulp, the industry might be encouraged through government investment funds to manufacture laminated wood products, furniture, newsprint and other papers. The additional processing would result in increased local economic activity as measured by value added.

In summary, all three models, results, and data bases are useful in a wide range of policy applications. After reviewing the relative numbers of policy uses considered for each model, the first model is most limited and is therefore the least favourable. The second and third models appear comparable in terms of potential policy applications, the only major difference being one of perspective. The second model views resource values strictly incident upon government while the third model takes a broader view of society. All three models have data bases which are also useful to government officials involved with policy and planning. No model has any particular advantage in this regard.

6.3 SELECTING ONE MODEL

While all three models have certain strengths and weaknesses, an appropriate next step is to select only one model which best satisfies the four criteria discussed in the previous section. One way to compare three models and four criteria is with a rating system, similar to that used to compare statistical characteristics of each model earlier in this chapter(Table 28).

TABLE 28

Rating of models and criteria.

Model Type	Criteria and Score				Total Score
	A	B	C	D	
1. Expenditure	0	2	1	0	3
2. Net Income	1	0	2	2	5
3. Net Social Value	2	2	1	2	7

where; A = Theoretical Basis
B = Practical Characteristics
C = Statistical Parameters
D = Policy Applications

For each criterion, the model which is most favourable scores two points; the second choice receives one point and the least favourable scores zero. If two models are judged to be equal in meeting a particular criterion, they receive the identical score.

On this basis the third model is clearly the most successful. It provides the best theoretical measure of value and yields the most favourable statistical characteristics. Also, in terms of practicality in obtaining data and deriving estimates, and for use in policy analysis, the third model shares the top score. This rating approach is subjective and implicitly weights each criterion equally. A more complicated method could be developed which incorporates various weights for the four criteria. However, such an approach may be no more objective and yield similar results. Therefore, the third model is judged to be the best for the purposes envisaged.

During previous discussions, little reference has been made to the actual values derived for Newfoundland in the beginning of the chapter. The main reason is that each model has different data and assumptions. Therefore, one cannot directly compare the results. A secondary reason is a wish to avoid ranking the models by the magnitude of the values produced. While the third model yields the highest forest resource values, this factor is not a reason for selecting this approach as the best model to use.

Having selected the net social value as the best approach among three alternative models, it is appropriate to summarize again exactly what the results mean. For the period 1977 to 1981, an average nominal value per m^3 of \$86.10 was calculated under a provincial accounting stance. This figure represents the average net social value, to the province of Newfoundland, resulting from the harvesting and processing of one m^3 of timber from the commercial forest. Under a broader national accounting stance, an average nominal value of \$82.29 was calculated for the same time period. This figure represents the average net social value, to Canada as a whole, resulting from the harvesting and processing of one m^3 of timber from the commercial forest in Newfoundland.

6.4 VALUING THE FOREST RESOURCE BASED ON AAC

The values in the preceding section are based on the current consumption of commercial forest resources, that is, the value to society only arises as this timber is utilized. One objective of this thesis has been to develop a valuation model based on AAC as well as current consumption. If the full AAC is not being utilized, what is the potential value to society from increasing consumption of forest resources to capture the full AAC? Also, what will be the potential value to society from increased investment in forest capital stocks, thus expanding future AAC and allowing the scope for increased resource consumption? These are important questions from a public policy perspective. In previous chapters, an intuitive assumption was made that as wood consumption increased over time, the net value of forest resources to society would also increase. Thus, as industry moves to capture the full AAC for example, one would expect total value added (in real terms) to rise accordingly. As shown in previous chapters however, this assumption is refuted by the data for Newfoundland. In each of the three models, there was little correlation between wood consumption and the measure of resource value in real terms. Thus, if we consider the third model only, real net social value will not change according to changes in wood consumption. If this conclusion is indeed true, there are serious policy implications to consider. As an example, one might question the wisdom of encouraging industry expansion to utilize the full AAC. Also, the current program of public investment in forest management to increase the future AAC may need to be reviewed. Clearly, if increased consumption of forest resources yields no corresponding increase in net social value, society may be better off maintaining resource stocks and wood consumption at current levels.

The opinion of this author is that the assumption linking increased net social value to increases in forest resource stocks and consumption is valid. As discussed in chapter 5, the main reason for a lack of strong correlation between net social value and wood consumption in Newfoundland is the lack of significant change in wood consumption over time. As the reader may recall, the production of industrial roundwood in Newfoundland from 1967 to 1981 was fairly stable within a narrow range. At the same time, real net social value increased. Therefore, a regression between these two variables cannot yield a definite trend-line with a high level of correlation. The scatter diagrams in Appendices 5 and 6 illustrate this situation. If, on the other hand, wood production in Newfoundland had steadily increased over the study period (allowing for occasional dips from year to year), the author contends that real net social value would have also increased. A stronger correlation would have resulted and a linear regression could have been used to estimate net social value arising from capturing the full AAC as well as increasing the AAC over time.

To test this theory, one can evaluate the relationship between resource consumption and social benefits in other regions over the same time period. Finland provides a good case study for comparison for several reasons. First, Finland's resource base and economy are dominated by forests and the forest industry. Approximately 65 percent of the country is forested. In addition, forest products form the largest component of commodity exports and net foreign exchange earnings (Anon., 1981d). In these respects, Finland is similar to Newfoundland and indeed the whole of Canada. At present, the contribution of forestry to national GDP in Finland is approximately 10 percent, a much higher figure than in Canada. Therefore the relative importance of forestry in Finland is greater. The Finnish government has recognized the role that forestry can play in economic growth and social welfare. In the 1960's, the government pursued policies designed to encourage expansion of both the forest resource and the forest industry (Riihinen, 1969). Public investments were directed into expanding processing capacity in the 1960's and late 1970's. Public investments to increase the future level of growing stocks have continued throughout the past three decades. Public funding of resource improvement programs has been carried out through direct government investment on Crown lands in addition to loans and grants to the corporate sector and owners of small private woodlots (Hirvonen, 1984). The government also encouraged the use of imported roundwood, particularly from the Soviet Union, to satisfy the increasing demand for fibre by the Finnish industry's expanded capacity. During the past three decades, industrial wood consumption in Finland has exceeded the volume available from indigenous forests under sustained-yield management (Anon., 1981d). Therefore, the government has supported industrial expansion through the use of imported raw materials while domestic wood supplies are being increased over the long term.

An implicit assumption made by the Finnish government in the early 1960's was that increases in economic growth and social welfare could be linked to expanded output from the forest industry (Riihinen, 1969). In other words, there was a strong correlation between industrial wood consumption and the level of net social benefits realized. To test this assumption, data from

Finland were used over the period 1967 to 1981.[1] The correlation between industrial wood consumption and real GDP generated by the forest industry is very strong. The value of r is 0.9723, while the value of r^2 is 0.9454. To provide a better comparison with the Newfoundland results, an estimate of real net social value was derived using the Finnish data. Nominal government expenditures on forestry such as reforestation and road construction, were deducted from nominal GDP generated by the forest industry. This net value was then changed into real terms by applying an appropriate index. The correlation between industrial wood consumption and real net social value was also very strong with an r value of 0.9716 and r^2 of 0.9439. Therefore, the assumption that there should be a strong correlation between industrial wood consumption and net social value is supported. In reviewing the data on wood consumption, one can easily see the definite upward trend, other than for a small period of decline in the mid-1970's. The range in wood consumption was between 33.1 and 55.6 million m^3, a difference of 68.0 percent. In Newfoundland however, the range was between 2.1 and 3.1 million m^3, a difference of 47.6 percent. Of more importance is that in Newfoundland, no strong trend in wood consumption and hence industry output is evident. The main point here is that the historical data for Newfoundland are such that insufficient change occurred from 1967 to 1981 to yield a strong correlation between wood consumption and net social value. As seen in Finland for the same time period, net social value is strongly correlated with, and can be predicted from, changes in wood consumption. Thus, the net social gains from increasing wood consumption to fully utilize AAC, or in the long-term, increasing the forest growing stock and hence AAC, can be estimated in Finland.

6.5 VALUING THE FOREST GROWING STOCK

Given that one cannot value the forest growing stock in Newfoundland using AAC due to the nature of historic data, an alternative approach is required. Since the forest resource values are based only upon timber that is

[1]Data presented in Appendix 7.

actually harvested and processed, how can values for the entire growing stock be derived? The problem becomes one of estimating the potential value of existing stands in various age classes. This potential value is only realized when the stands reach maturity and are utilized by the forest industry. Therefore, the concept of valuing these stands revolves around accounting for time by discounting potential future values into present values. A simple example can illustrate this approach.

First, assume a commercial forest that is perfectly regulated with a rotation age of 10 years. Second, assume there are 10 compartments in this forest, all of equal size. Third, assume that each compartment yields an equivalent volume after 10 years. Thus each year, one compartment will contain a stand of mature trees of 10 years of age. This compartment is cut and then planted with seedlings which will yield a new mature stand in 10 years. In the following year, the compartment which was previously nine years of age reaches maturity (10 years of age), is cut and then replanted. This cycle continues so that after 10 years, trees replanted after the first mature compartment was cleared, now reach maturity and are themselves cut.

To value the forest requires some measure of current and future net social value. To assist in using the results from this study, assume for the moment that the current year is 1983. Thus, the data to 1981 represent a realistic situation with a time lag of two years between the current year and publication of data for this model. The nominal value of $86.10 per m^3 therefore represents the latest value available under a provincial accounting stance.

There are three possible approaches to use in estimating the 1983 net social value from the last average value derived for the period 1977 to 1981. One approach would be to assume the value of $86.10 reflects the current situation for timber utilized in 1983. An implicit assumption is that values remain constant over time in real terms. This assumption is incorrect. From data in Appendix 5, real net social value does in fact increase over time at an average rate of 3.83 percent. Clearly, using $86.10 per m^3 to represent 1983 values would lead to an underestimate.

A second approach would be to compound forward to 1983, the average value for 1977 to 1981. The compound factor to use is the annual average percentage change for nominal net social value per m^3. For the provincial values, this figure is 11.82 percent. Thus, the 1983 value is an estimated \$107.66 per m^3.

A similar method involves deriving a trend-line from the time-series data to 1981. The resulting equation can be used to estimate data points for any year in the future. Using nominal data, the following equation is produced (Equation 4);

$$[Y_n = 6.1094\,(X_n) - 12010.27] \qquad \text{(Equation 4)}$$

where Y = Net Social Value In Year n
X = Year n

For 1983, the equation yields a net social value of \$104.67 per m^3. This latter approach is the most statistically sound since it is based on the technique of simple linear regression using ordinary least squares. Thus, the equation represents the best fitting straight line using historical data. While no method can predict the future with full certainty, this approach is best among various alternatives.

The preceding equation (Equation 4) can be used to estimate values for the hypothetical forest in this example (Table 29). The forest is presented with each compartment numbered 1 to 10 and with the year in which the growing forest will reach maturity for harvesting and processing (Figure 15). As indicated, compartment 10 is being cut in the current year, compartment 9 next year etc., until compartment 1 is cut at the end of the cycle in 1992. To estimate a value of the growing stock in 1983, two additional assumptions are required in this example; first, that upon maturity, each compartment yields a merchantable volume of 100 m^3; second, for the purpose of discounting future values back to 1983, a discount rate of 10 percent is used. The selection of a discount rate is a topical issue which warrants discussion. However, to avoid complicating this simple example, a single rate will be used. A detailed discussion is provided in chapter 7.

TABLE 29

Present value of example forest growing stock.

Compartment Number	Future Value[1] ($)	Years to Harvesting	Discount Factor(%)[2]	Present Value[3] ($)
10	10467.02	0	1.00	10467.02
9	11077.96	1	1.10	10070.87
8	11688.90	2	1.21	9660.25
7	12299.84	3	1.33	9248.00
6	12910.78	4	1.46	8843.00
5	13521.72	5	1.61	8398.55
4	14132.66	6	1.77	7984.55
3	14743.60	7	1.95	7560.82
2	15354.54	8	2.14	7175.02
1	15965.48	9	2.36	6765.03

[1]From (Equation 4) x 100m^3 per compartment.
[2]Calculated as $(1 + i)^n$ where i = 10%, n = number of years to harvest.
[3]Calculated by dividing future value with discount factor.

The sum of the present value figures is $86173.11 which respresents the net present social value of the entire forest growing stock in 1983. If the area of each compartment was one hectare, the average net present social value on an area basis would be $8617.31 per hectare.

An alternative approach to valuing the growing stock of the hypothetical forest is by using area values. From Appendix 5, time-series data on net social value per hectare of forest harvested are available. Thus, a trend-line equation can be derived to estimate future values for each forest compartment which, when discounted, yields a net present social value on an area basis. The approach is identical to the example in Table 29 except that values per hectare rather than values for m^3 are used.

The preceding examples apply to a perfectly regulated forest over one rotation. Assuming that forestry activity on this hypothetical forest will continue in perpetuity, an alternative approach to estimating net social value is

1 (1992)	2 (1991)	3 (1990)	4 (1989)	5 (1988)
6 (1987)	7 (1986)	8 (1985)	9 (1984)	10 (1983)

where: - top number is the compartment number
- bottom number is the harvesting year

Figure 15. Example forest for valuation by model 3

possible, based on an infinite series of rotations. The formula for deriving the capital value of a permanent income is (Equation 5);

$$V_0 = \frac{a}{i} \qquad \text{(Equation 5)}$$

where; V_0 = present value of a sum of money earned from a property
a = annual value of money earned from a property
i = discount rate.

(Davis, 1966)

Since one is estimating the net social value generated from the example forest over an infinite time horizon, the present value of the one compartment harvested in the current year (in our example 1983) is used to represent the net social value which the entire ten compartment forest will yield each year, in perpetuity. Thus, the capital value of the forest is;

$$V_0 = \frac{\$10,467.02}{0.10} = \$104,670.20$$

There will always be a difference in value depending upon whether one calculates values over one (or several) rotations, or an infinite series of rotations. In this example, there is a substantial difference between the two estimates; \$86,173.11 versus \$104,670.20. This wide variation is due mainly to the short rotation period of 10 years. As the rotation period is increased, the difference in value between the two approaches will decline.

The preceding examples illustrate simple approaches to valuing the entire forest growing stock. These methods are based on the assumption of a perfectly regulated forest where the full AAC is being utilized. In Newfoundland, these conditions are not present, however the valuation techniques discussed in this section can still be applied and will comprise one of the policy applications in the next chapter. The key point in each of these approaches is that by using net social value instead of poorer measures such as administratively set stumpage prices, government policy makers will have improved forest resource values to work with.

6.6 SUMMARY OF CHAPTER 6

The main objective of this chapter was to evaluate each of the three models under various criteria and select one as representing the best approach in forest resource valuation in Newfoundland. Four criteria were used. First, all models were judged on their theoretical soundness relating to the nature of the resource values produced. Second, the practical side of each model was assessed in terms of ease of calculation and availability of data. Third, several statistical characteristics of the time series data bases used by each model were compared. Finally, the relevance of each model, data base and resulting values were discussed. Based on these criteria the third model, net social value, was judged to be the best approach. While each model exhibited particular strengths and weaknesses, the third model most strongly satisfied the four criteria.

As shown in chapter 4, this model yields a partial estimate of net social value for commercial forest resources using both a provincial and national accounting stance. Values are based on value added and government forestry expenditure associated with industrial harvesting and processing of commercial stands. Due to the time lag between this activity and the publication of data required by the model, the resulting values are normally two years out of date. Thus, the model does not produce current values. Also, the values relate only to timber already utilized, not to the forest growing stock as a whole. Each model failed to exhibit a strong correlation between industrial wood production and resource value. Therefore, values could not be derived based on AAC which is a reflection of the total forest growing stock.

To be effective in policy analysis, an alternative method was needed to produce values based on the total growing stock and to eliminate the two year data lag. A simple method was developed which uses a trend-line equation derived from the time-series data to estimate current and future net social value for stands of any age. Future values are discounted, based on the number of years until harvest, thus yielding present values. Alternatively, the entire forest growing stock can be valued based on permanent income over infinite rotations.

7.0 POLICY APPLICATIONS

7.1 BACKGROUND

As discussed in previous chapters, a primary function of any valuation model must be in the area of policy formation and analysis. A policy can be defined as the principles guiding a settled course of action determined by a government, institution, body or individual (Worrell, 1970). Policy formation itself is only one component of the decision-making process. The major steps in this process are:

- definition of goals,
- identification of alternative means and strategies to achieve goals,
- establishing policies to facilitate the chosen course of action to achieve established goals,
- evaluation of results.

1. Definition of Goals

All countries have broad social and economic goals as a foundation for planning and policy-making. In Canada, the process of establishing these broad goals occurs at both the national (federal) and regional (provincial) level, given our system of confederation. At the macro-level, economic goals include increased gross domestic product per capita, full employment, equitable distribution of income, reduced inflation and stable balance of payments (Nadeau, 1981). These types of goals relate to the economic aspects of society, or the economic well-being of man. Social goals on the other hand, refer to the non-economic aspects of society and include improved environmental quality, public health, education and general social welfare (Samuelson, 1976). Social goals therefore address quality of life or human welfare.

The economic and social goals described previously should ideally be identified through extensive discussion involving all groups and individuals comprising society. In practice however, these goals are often defined as a formal statement from governments on behalf of society. Goals are established from a mixture of historical precedent, political opportunism and assumptions about public attitudes (Sewell, 1977). One possible consequence may be conflicts between the goals perceived by government and those perceived by other social groups. In Canada, this situation can be exacerbated by the differences in resource ownership, legal jurisdiction, and policy between the federal and provincial governments.

As described in chapter 2, forestry clearly contributes to the economic welfare of Canadians through the generation of income, employment and exports. These contributions are especially important in Newfoundland, given the province's weak economic base. The forest resource also contributes to social welfare by providing a habitat for non-timber outputs such as wildlife, areas for recreation and maintenance of environmental quality.

In Newfoundland, as in most regions of the country, the most widely acknowledged role of forestry is its economic functions. This situation is due to the historical prominence of forestry in the development of the national economy, and the fact that the economic outputs from timber production are visible and easily quantified (Milne, 1986). Despite the emphasis on economic functions, there is a virtual absence of long-term goals which specify forestry's role in addressing the broad macro-economic goals of the province. For example, there appears to be a lack of published government statements which define the percentage of provincial GDP or employment which should be met by forestry. In the author's opinion, clearly defined goals of this nature are a necessary prerequisite for effective public planning related to the forestry sector.

Under a more narrow "micro" view, goals relating to forest resources are common, for example, the goal of regulating the forest under a sustained-yield management system, or reducing the area of non-stocked forests by "x" percent over a given time period. In Newfoundland, there are many examples of these types of forest resource goals which are defined by government agencies. Since 1974, such goals have been an integral part of the three federal/provincial cost-shared Forestry Subsidiary Agreements. Often however, the goals are not specific, a problem which limits the effectiveness of the decision- making process.

2. Identification of Alternative Means and Strategies to Achieve Goals

With any goal or objective, there will usually be several possible courses of action available to achieve the desired aims. Ideally, one should evaluate each alternative under a range of criteria. For decision-making involving forestry resources, there is a wide variety of simple financial models which can be applied, such as breakeven analysis, marginal analysis, minimum payback, maximizing net present value or internal rate of return. More complex models incorporating risk, uncertainty, probabilities, constrained and unconstrained activities etc. are also available (Duerr *et al.*, 1975). Financial analysis of alternative courses of action is only one approach and is limited in that it can ignore non-financial characteristics (Marty, 1975). In conjunction with the financial analysis, Marty states that each alternative should be evaluated in terms of its impact on the environment, creation of indirect costs and benefits, and the nature of any distributional effects.

3. Establishing Policies to Facilitate Goal Achievement

Policy formation is the process of preparing a systematic statement of the settled future course which a society has agreed to follow (Worrell, 1970). Thus in the case of Newfoundland's forest resources, policy formation is normally the role of the provincial government. Forest policies can emerge through two main avenues; either by legislation in the government assembly, or by a formal statement of policy from a provincial government department. One should recognize that just as goals change, so do policies. As more information on the forest resource becomes available, government or other sectors of society can assess the adequacy of current goals and policies. As the needs of society and demands on forest resources change, one finds both goals and policies gradually evolving into different forms. Using an example of fire protection, an initial goal may be to reduce fire losses in forests by 50 percent from historic levels. Policies relating to forest access, fire detection and suppression, and harvesting regulations for industry will then be established. If the results are found to be far short of the desired goal, new policies can be drafted, or the goal itself redefined. Another factor which can act to change policy is the effect of public pressure either in favour of, or against a given policy. Obviously most policies will impact in some way upon people and ultimately there are winners and losers. With the majority of forest resources in Newfoundland under Crown ownership, the provincial government has a wide scope for establishing forest policies which affect a large segment of the population. The public response to different policy initiatives can therefore greatly influence the magnitude and direction of forest policy.

A prime example of public influence in Newfoundland forest policy is related to the recent spruce budworm outbreak (1972 to early 1980's), and efforts to control the insect using aerial spraying of pesticides. The provincial government began following a policy of aerial control in 1977 after strong lobbying from the forest industry. The evidence was becoming quite clear that unless control efforts were initiated, the future viability of the industry, viz-a-viz wood supplies, was threatened. From a modest start of 76,000 hectares sprayed in 1977, the protection program encompassed 378,000 hectares in 1978. However, at the same time, public pressure began to mount against the spray program. Primarily through the newspaper media, concerns over the effects of spraying were voiced by citizens' groups, environmental groups and individuals. With a provincial election looming in 1979, and in the face of increasing public concern, the government reversed its policy of using chemicals. In 1979, only 6,000 hectares of forest were sprayed using a biological control agent (*Bacillus thuringiensis*). By comparison, the area of moderate to severe defoliation in 1979 was nearly 1.0 million hectares. In 1980, the government again maintained a policy of non-chemical control despite the lobbying efforts from industry. Unable to make a decision on the matter, the government appointed a Royal Commission of Inquiry in early 1980. The Commission heard evidence from forestry experts, medical experts, government agencies, public groups and individual citizens. The Commission's first report, dealing primarily with forest protection, was released in early 1981. The report clearly recommended that a policy of chemical protection be re-established, and also refuted the claims of environmentalists that the chemicals were harmful;

> "It is difficult to give the three insecticides named a ranking in terms of environmental or human health acceptability. Neither of them has shown any evidence of persistent environmental damage to aquatic or terrestrial organisms. Also, the aerial application of the insecticides have had no known adverse human

health effects. No mutagenic or teratogenic effects have been identified and chronic effects, including carcinogenic activity, are not known to occur from even long-term exposure. Reye's Syndrome has not been linked to forest spray programmes and the viral enhancing effects attributed to formulations of these chemical insecticides have never been substantiated."

(Poole *et al*, 1981 a.)

Given these assurances, the government approved a policy of aerial protection using chemical insecticides. Also, an increased program of public education was undertaken to provide factual information on chemical protection to the general public. This example illustrates how public response to a policy initiative, albeit ill-informed, can greatly influence the policy and effect enormous changes.

4. Evaluation of Results

One of the most important steps in decision-making or the whole planning/policy process is the evaluation of results. As discussed in the previous section, by comparing results to the established goals, one can evaluate the degree of success achieved and make any necessary changes to goals and/or policies. Thus, the entire process is iterative in nature, constantly changing over time. The process of evaluation is facilitated by the existence of well-defined goals and objectives, and explicit values which provide some measure of the net benefits to society.

This latter point is the cornerstone of the study; that is, for governments to develop efficient and effective forest policies in the context of the overall decision-making process, adequate measures of resource values must be available. A central theme is that stumpage prices in Newfoundland undervalue the resource when used in policy formation and analysis. From previous chapters, a model was developed which values Newfoundland's forest resources based on the net economic benefits created through the harvesting and processing of commercial timber. Thus, the model is strongly related to the economic goals of society and the economic function of the forest in addressing these goals. While there may be potential policy applications of the model at this broad macro-level, as discussed earlier these goals are poorly defined in practice. Also, the fact there is no strong correlation between net social value and timber production in Newfoundland is a further constraint. For example, it would be difficult to determine the overall increase in future provincial GDP from an expansion in forest stocks using public funds. While these problems are a limiting factor, they do not preclude the use of the model in other types of policy application.

There are many requirements for improved resource values at the micro-level in forest policy, using the Newfoundland situation. The objective of this chapter is to illustrate several examples where the resource values derived in Model 3 can be of use in forest policy development. This procedure is of interest because of the fact that most forest policies in existence in Newfoundland occur at the micro-level. In the following policy applications, the reader should note that the actual numbers which are used are not viewed as being of central importance. The intent in this chapter is to show **how** the resource values can be applied to real policy examples.

7.2 DISCOUNTING AND SELECTING A DISCOUNT RATE

In the previous chapter, reference was made to discounting in the hypothetical valuation of a forest resource. At this point, a more detailed discussion of the discounting process and selection of an appropriate discount rate is required. In the policy applications of Model 3 which follow in later sections, discounting will be used, therefore the reader should be provided with some basic background information on this subject.

Discounting is a procedure for evaluating cost and benefit streams which occur at different time periods. The purpose of discounting is to place these costs and benefits into a common time frame, usually the present. Therefore, discounted values which occur in the future are transformed into present values for evaluation and comparison. The foundation of discounting is that a dollar received now is worth more to an individual than the promise of a dollar in the future. As an example, an individual will prefer to receive $10 now, rather than $10 in five years. The underlying principle is that $10 received now is available for alternative investment or consumption opportunities. These opportunities are foregone if the individual must wait five years to receive the $10. Therefore, the concept of time in imposing a cost is important. Discounting future benefits reflects the value of more immediate returns foregone, while discounting future costs reflects the more immediate returns available from postponing costs to the future (Gillen *et al.*, 1979).

The use of discounting is an accepted fact by most economists and business analysts involved in assessing the efficiency of both public and private investment alternatives or currently ongoing programs. Foresters however, often deplore discounting when it is applied to investments in the resource base. The main reason for the distrust is that the unusually long time period required to receive benefits (in the form of mature timber) results in low present values. Regardless of the discount rate used, increasing the time period of future benefits reduces their discounted value in present terms. For example, with a discount rate of 10 percent, the present value of $100 which will be received in five years is $62.09. In comparison, the present value of $100 which will be received in 60 years (discounted at 10 percent), is only $0.33. Given the long rotation periods of forests in Canada and low timber values as reflected by stumpage prices, the net present value of reforestation for example, can often be negative. For specific studies, the reader may refer to (Anderson, 1979; or Milne, 1981a). Foresters often claim these factors harmfully bias forestry when using discounting and that forestry can appear to be a poor avenue for investment of public funds.

In this study, the use of discounting to place cost and benefit streams into a common time frame is considered an effective and efficient financial tool in the context of policy development and analysis. The fact that forestry has a long period of benefit maturation is not sufficient to justify discarding the use of discounting entirely. Accepting the need for discounting in forest economics, one is faced with the task of selecting an appropriate discount rate.

The choice of a discount rate is critical when assessing alternative investment opportunities or ongoing programs. This topic has been a subject of considerable debate among economists.[1] The actual rate used is an important factor in the calculation of present values. As an illustration, the present value of $100 discounted at 10 percent over 20 years is $14.86. On the other hand, using a discount rate of 5 percent results in a present value of

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[1]The reader must refer to (Arrow and Kurz, 1970; Baumol, 1968; Baumol, 1969; Foster, 1979; Harou, 1985; Helliwell, 1974; Marglin, 1963; Mishan, 1975; Price, 1973).

$37.69. This effect is more pronounced as one increases the period of time. Clearly, high discount rates will favour projects with early returns while lower rates can encourage projects with a more lengthy time profile (Gane, 1969). Thus in the case of forestry, with its long time period of benefit maturation, the choice of discount rate is especially important and is central to many areas of forest policy such as resource allocation, exploitation, conservation and regeneration.

There are two schools of thought, each with supporting literature, on how the discount rate should be selected (Howe, 1971). The first approach is the social opportunity cost (SOC) which advocates a relatively high discount rate to reflect the rate of return foregone on investments in the private sector when funds are transferred to the public sector (via taxation for example), to finance public investments. The basic principle here is that these public investments should earn a rate of return at least equal to the rate of return which could have been earned in the private sector (Howe, 1979).

The second approach is the social time preference (STP) which argues for a lower discount rate on the premise that society as a whole is willing to postpone current consumption and accept more modest rates of return. Society, in this case is concerned with deferring present consumption to the future. A common argument is that society holds a myopic view of the long-term, thereby overestimating present consumption and underestimating future benefits. A low discount rate (compared to SOC rates) is preferred to give more weight to benefits accruing in the future. According to Howe (1979), the STP rate need bear no relation to the rates of return in the private sector.

In theory, the SOC and STP rates should be equivalent (Harou, 1985). The underlying foundation is that STP represents the return on savings as society defers present consumption, while SOC represents the return on funds invested in current consumption. In equilibrium, the return from savings would be identical to the return on investment, therefore the rates of SOC and STP would balance. In summary, society would be left with a single discount rate. For this condition to hold, the theory requires several assumptions; no corporate income tax, perfect knowledge of all investment opportunities, and complete mobility of capital. Clearly, in the real world these assumptions are not valid. The effects of corporate income tax and risk tend to raise the discount rate in the private sector to attain a pre-tax return on investments.

Also, there are a wide range of savings and investment opportunities available although consumers may not possess complete knowledge of these. In the real world therefore, one finds a divergence between a STP discount rate and a higher SOC rate.

This divergence is the chief cause of debate over the question of selecting the "correct" discount rate for use in public policy analysis and gives rise to the two alternate approaches of SOC and STP. Proponents of the STP rate argue that government should accept a lower return on investment, especially for long-term investments which favour future generations. On the other hand, proponents of the SOC rate argue that public investments or ongoing programs should earn the same rate of return as would occur in the private sector. Certainly, such an approach would maximize the returns on public funds invested. However, evaluating returns in the private sector to provide some guidance on selecting a discount rate for public investments is difficult. A point often overlooked is that the public and private projects being compared in selecting a discount rate must be of a similar type and longevity (Gane, 1969). Also, judging private sector performance only from the more successful examples with high rates of return, and ignoring failed investments, will result in an overly high average discount rate.

Given these two approaches to select a discount rate, what is the range in rates from previous studies? For the SOC rate, Haveman (1969) estimated a real rate of 7.3 percent for 1966. According to Howe (1971), a re-estimate for the 1970's would be in the order of 10 or 11 percent. Mishan (1975) suggested a real SOC discount rate ranging from 7 to 15 percent. Jenkins (1972) in a widely cited study of numerous Canadian industries for the period 1965 to 1969, estimated real rates of return from 2.8 to 15.1 percent, and an average of 9.5 percent. Clearly, a range in discount rates exists.

For the STP rate, there is less divergence. Howe (1979) stated that the federal water agencies in the United States might use a real rate of 5.5 percent in project analyses. In Canada, Reuber and Wonnacott (1961) estimated the real rate of return on Government of Canada bonds to be 4.75 percent. A study by Kula (1984) estimated a real STP rate for Canada of 5.2 percent.

In forestry, the quest for a discount rate follows similar lines. Some authors like Price (1976), argue that forestry should not be treated differently than other sectors in selecting a discount rate. This school of thought favours using a SOC rate. Others, like Leslie (1967) claim that forestry should use a lower STP rate in face of the long time horizons and uncertainty in managing these resources. In Canada, this argument is frequently heard, based on the long time period of forest maturation and high level of public ownership of the resource. With respect to specific discount rates, Harou (1985) reviewed several studies with real STP rates in the range of 4 to 6 percent, and a real SOC rate of 10 percent. A recent study by Fraser (1985) for forestry in Canada, suggests a range between the real STP and SOC rates at 5 and 10 percent respectively.

From the literature reviewed, one clear fact is that no single discount rate is suggested for use in forestry, either generally, or specifically for Canada. In the experience and opinion of this author, the selection of a discount rate for public forestry investments is highly subjective and depends to a large extent upon personal adherence to either the STP or SOC school of thought. The literature can only provide guidance as to what a reasonable range in rates might be. For this study, a rate of 7.5 percent is selected. This rate strikes a "middle ground" between the two approaches of STP and SOC, if one assumes the former is represented by rates in the order of 5 percent, and latter by rates in the range of 10 percent. This approach of finding common ground offers simplicity in that only one rate is used in calculations which follow, however it does not provide for sensitivity analysis. By using a range in discount rates, such as 4, 6, 8 and 10 percent, one can test the response of results to changes in the discount rate. As discussed earlier in the chapter, forestry investments are highly sensitive to the discount rate. While supporting the general principle of sensitivity analysis, it must be re-stated that the primary objective of the chapter is to illustrate how the net social value model can be used in policy applications in Newfoundland. A single discount rate is sufficient for this purpose and will avoid complicating the analysis.

7.3 CASE 1. THE NEED FOR INCREASED FOREST PROTECTION

7.3.1 Background

Forest protection is generally recognized as a primary component of modern forest management programs. Certainly, under an intensive forest management program with large expenditures on forest renewal and stand tending, protection from fire, insects and disease is required to prevent losses to these investments in forest capital (Reed *et al.*, 1978). Even under extensive forest management where investments in forest capital are minimal, some level of protection is needed to reduce losses to the forest growing stock. Historically, one of the first steps in establishing basic forest management programs in North America was the initiation of forest protection, primarily against fire (Davis, 1966). Newfoundland was no exception to this pattern, although efforts to establish a formal fire protection system under government control did not occur until the early 1960's (Munro, 1978). As the level of forest management gradually evolved from an extensive to a more intensive approach, forest protection began to include control over insect damage. Presently, research is continuing on the problem of reducing disease losses in a cost-effective manner. In practice however, current forest protection programs are aimed primarily at fire and insects.

7.3.2 Economic Considerations

In forest protection one must balance program costs with the level of protection desired. In the case of fire, a realistic approach is to accept a certain level of average fire losses over time. Fire detection and suppression costs are thus planned for on the basis of an "average fire year". This approach is generally used throughout Canada. While exceptionally high fire losses may occur from time to time, these are usually infrequent and require several contributing factors to come into play such as low winter snowfall, followed by a dry spring and hot summer etc.. To plan a fire protection program on the basis of these infrequent, albeit high losses would incur prohibitive costs and result in excess protection capacity for much of the time. Thus, programs based on average fire losses are a normal annual expenditure required to maintain the forest resource base while accepting a certain level of fire damage. The same approach can be applied to insect damage where such damage is small and normally might occur each year. Massive insect outbreaks must be treated differently. Unlike fire where a high-loss year will only last the one year, an insect outbreak can span several years. Thus, sustained protection measures beyond normal or average levels may be required. The policy option to consider is one of determining the maximum amount of additional protection expenditures which can be justified based on the values at risk. The approach here is to view these extra protection expenditures as an investment since under "normal" forest conditions, they would not occur. Clearly, some measure of forest resource value is required to assess the balance between protection expenditures and potential losses to the forest growing stock.

As the reader may recall from earlier chapters, Newfoundland was subjected to a severe outbreak of defoliating insects from the early 1970's to the early 1980's which resulted in massive forest damage. Owing to a combination of factors such as public fear over aerial chemical spraying, a lack of public awareness of the insect problem, and provincial government elections during the outbreak, adequate protection measures were slow to develop. A point to consider is what would have been the government's response to the situation if, in the early 1970's, a better measure of forest resource value had been available. By using the net social value model to evaluate the forest resource, as opposed to stumpage rates for example, a more realistic estimate of values at risk would have been made. With this improved information on resource value, perhaps different policy decisions would have been taken. While results in the study cannot turn back the clock, there is always a possibility of a future insect outbreak. Therefore it is a worthwhile exercise to estimate the net social value of Newfoundland's commercial forest resources using Model 3.

7.3.3 Net Social Value of Newfoundland's Forest Resources

As an initial step in the valuation process, several assumptions must be made. First, the reader should note that the forest resources being valued refer only to productive forests currently used to supply commercial forest products. Thus, only productive forests under tenure to the pulp and paper industry, and unalienated Crown forests can be considered. In this context, productive forests under tenure to municipalities and the federal government cannot be included since these are not used to supply industry with commercial timber. From Table 3 in chapter 2, the area of productive forest available to supply commercial timber is 3,659,000 hectares including only unalienated Crown and industry-tenured productive forest.

A second assumption is that only pulpwood, sawlogs and a small volume of miscellaneous timber comprise the commercial primary uses of the timber harvested by industry. Thus, one can only consider industrial fibre harvested. From chapter 2, the reader may recall that domestic fuelwood (non-industrial fibre) accounts for 25 percent of total softwood consumption. While this fibre is a drain on the resource base, much of the wood is of non-commercial size. The contribution to provincial GDP by fuelwood consumption is difficult to estimate. Nearly 80 percent of domestic fuelwood is cut by individual householders for personal use. Thus, there is little commercial activity in the form of private firms cutting and selling fuelwood which would be included in GDP statistics. Certainly, by burning fuelwood, consumers save money on their heating costs. These savings represent an "income-in-kind" which is available for expenditure on other commodities which would be measured in GDP statistics. Also, from chapter 2, the cash injection into the Newfoundland economy through direct fuelwood purchases from commercial operators and expenditures by individuals cutting their own wood was an estimated $4.6 million in 1983. This cash injection, however, must be balanced by reductions in economic activity in other energy sectors, namely the fuel oil and electric power industries. There are insufficient data to compare the economic gains versus losses from the use of domestic fuelwood in Newfoundland. For this study, fuelwood is not included.

A third assumption relates to the concept of forest regulation. In the hypothetical example in chapter 6, a perfectly regulated forest was used, with 10 individual compartments each having one age class, under a 10 year rotation. This forest therefore yielded an equal volume of timber for harvest (at maturity) each year. In Newfoundland, the forests are not perfectly regulated. There is currently a preponderance of mature and overmature timber in the province, a situation which is common throughout most of Canada, although in Newfoundland, much of this volume is dead or dying due to budworm damage. The provincial government is pursuing a regulated forest structure through a policy of sustained-yield management. Thus, over a period of at least one rotation, the maximum AAC is equivalent to annual forest growth and means that an even-flow volume of maximum harvest is available each year. During the process of regulation, the old-growth stands are harvested first, over a period of time long enough to achieve a more balanced age-class structure. The main point here is that although the forest is not regulated at present, a policy of sustained-yield management results in relative stability of annual yields each year, much as a regulated forest would provide.

A fourth assumption is that current harvesting levels and the structure of the forest industry will continue into the future. Realistically, one might expect changes in either factor to occur . However, as shown in this study, for small changes in harvesting, the net social value of Newfoundland's forests may not be altered. Also, the severe forest losses created by the spruce budworm during the past 15 years have cast doubts about the potential for substantial expansion in the industry's scale. Wood supplies can be increased, but only over several decades given a rotation period of 60 to 70 years.

A final assumption is that under a policy of sustained-yield forest management, the productive forest resource base will be maintained over time. This assumption implies that necessary expenditures will be made to reforest cleared areas back to a mature forest, yielding timber volumes equivalent to those harvested previously. Therefore, the AAC of 3.0 million m^3 will be maintained over time.

With these background assumptions stated, there are two methods of valuing the productive forest resource in Newfoundland following the example in chapter 6. The first approach would be to value the resource base on an individual stand format. With information on stand volumes, area, age and time to harvest, one could calculate the net social value (in present value terms) for each stand over any number of rotations. The sum of present values for every stand would equal the net social value of the forest. Only stands which would be utilized commercially would be counted. Productive stands outside the extensive margin of production for example, could be excluded on the basis that they would never be cut for industrial use, given current industry structure and mill location. This approach lends itself to modern computer-based analytical techniques such as dynamic programming. However, the required levels of inventory data, combined with an efficient computer storage and retrieval system, are not yet fully developed in Newfoundland. Efforts are continuing by the Department of Forest Resource and Lands in this regard but results will not be available for some time. This approach, therefore, cannot be used at present.

The second approach is to value the productive forest as an aggregate rather than on a stand by stand basis. The reader may recall from the example in chapter 6, that the approach uses the formula for capital value over an infinite series of rotations, that is (Equation 5);

$$V_0 = \frac{a}{i} \qquad \text{(Equation 5)}$$

where; V_0 = present value of a sum of money earned from a property,
a = annual value of money earned form a property,
i = discount rate.

In the case of Newfoundland's forests, "V_0" is the present value of net social value for commercial, productive forests. The term "a" is the net social value yielded by the entire forest in any year. The term "i" is the discount rate. To calculate the "a" term in current 1986 values one must either use more recent data (than 1981), or use the time-series data and trend line analyses to project 1986 values. In the absence of more recent data, the second method is used here. From nominal data, the following trend-line equations are derived for values per m^3;

Provincial : Value In Year z = −12010.273 + 6.1094 (Year z)

National : Value in Year z = −12619.710 + 6.4161 (Year z)

For a provincial accounting stance, the net social value per m^3 is \$123. For a national accounting stance, the same value is obtained. Thus, while the values obtained from a 5-year average (1977 to 1981) in chapter 5 showed a slight difference, projections to 1986 based on the full time-series of data yielded equivalent results. With a net social value per m^3 of \$123 in 1986, the next step is to obtain a value for the total volume harvested which then represents the term "a". The average volume of industrial wood harvested from 1967 to 1981 was 2,345,200 m^3. Therefore, the total net social value estimated for 1986 is \$288,459,600. This number represents the net social value arising from the harvesting and processing of 2,345,200 m^3 of commercial timber. From the capital value formula, the present value of this flow of benefits V_0 is;

$$V_0 = \frac{a}{i} = \frac{\$288{,}459{,}600}{0.075} = \$3{,}846{,}128{,}000$$

Dividing "V_0" by the total area of productive forest used for commercial timber supply results in a net social value for this entire forest area. Therefore, using the forest area of 3,659,000 hectares derived earlier in this chapter, the net present social value of these forest resources is \$1051 per hectare.

One should note the sensitivity of the capital value to the discount rate used. At a real discount rate of 5 percent, a capital value of \$1576 per hectare results. Using a rate of 10 percent, the capital value is only \$788 per hectare. Obviously, such a wide fluctuation in the figures means that the choice of discount rate can have a great impact on subsequent policy decisions. In this study, a rate of 7.5 percent has been selected for use in several policy examples. As discussed earlier in the chapter, a range of rates exist which can be used. The reader should realize that when this type of model is actually used by governments in policy development and analysis, the selection of a discount rate would become a primary issue for discussion.

7.3.4 Policy Implications

With the aggregate net present social value of \$3.8 billion, and a unit value of \$1051 per hectare, policy-makers can more effectively assess the values at risk from a potential insect outbreak. As a comparison, using an average stumpage price of approximately \$5.00 per m^3 (weighted for different rates between pulpwood and sawlogs), a present value using the same formula and discount rate is \$43.00 per hectare. Clearly, the values at risk are greatly underestimated using stumpage as the measure of value. With a more realistic measure of value, the decision to increase forest protection above normal levels may be less difficult to justify.

A second policy use is in setting a limit for these additional protection measures and their associated cost. The $1051 per hectare figure is a present value based on an infinite series of rotations. Therefore, one can justify additional protection expenditures with a present value of up to the maximum of $1051 per hectare over an infinite series of rotations. Obviously, predicting the exact level of additional expenditures which may be required over this time period is virtually impossible. However, this need not pose a serious problem. Extremely bad insect problems may arise infrequently if normal levels of protection occur. One can try to predict the number of times per rotation serious outbreaks may occur. Using past data on insect protection costs, estimates of additional expenditure needed for the current potential outbreak can be made. Having done this, one can then assess the amount of unused expenditure which remains out of the maximum $1051.00 per hectare.

From data on the previous insect outbreak in Newfoundland (Milne, 1984c), average aerial spray programs cost $11.22 per hectare in 1983 dollars. Clearly, there is a wide scope for increasing the extent of forest protection above normal levels when compared to the value at risk of $1051.00 per hectare. More importantly, these expenditures could be justified for an indefinite period of time. As an example, the capital value of $11.22 over an infinite time span and using a real discount rate of 7.5 percent is only $150. Therefore, one could spray every hectare of the productive, commercial forest, every year if necessary, and still be well below the $1051 figure. This type of analysis illustrates that increased forest protection can be justified against the threat of a serious insect outbreak which potentially could cause widespread forest losses.

7.4 CASE 2. LAND-USE CONFLICTS

7.4.1 Background

A growing concern among resource planners in Newfoundland is the often intractable problem of conflicts in land-use between forestry and other single uses such as recreation, agriculture and hydro-electric development. Among officials in the forest industry and related government departments, the alienation of forest land to non-forestry uses is emerging as a major issue of the 1980's. There appear to be two main factors contributing to this problem

(Draper and Storey, 1984). First, the application of multiple-use land management has had little progress in Newfoundland. Although many uses of forest land are compatible with commercial timber production, for example widlife, few serious attempts have been made to integrate land-use in this manner. Instead, the concept of single-use designation remains as the most common land-use approach. From the perspective of forestry, alienations have the effect of prohibiting timber production, thus further constraining wood supply.

A second factor of importance is the apparent lack of comprehensive land-use planning by the provincial government. Ideally, one government department should maintain overall responsibility for land-use planning and policy. As a result, a more coordinated approach to the allocation of land for timber production, recreation, wildlife, agriculture, and hydro-electric developments would occur. The current situation in Newfoundland is far from being ideal. There is no one single agency which takes precedence over all others in land-use policy. Instead, each individual department such as Wildlife, Agriculture, Forestry etc., maintains an internal capability and an assumed responsibility for land-use planning and policy. Obviously, internal department priorities over land-use planning and policy relate to the resource which the department is responsible for. Therefore, each department conducts land-use planning and policy-making within a very narrow viewpoint rather than the broader framework of considering all land resources. The result is often seen in conflicting plans and policies over land-use among various departments. There is no agreed method for assigning values to different resources, or indeed for actually comparing alternative land-uses. The model developed in this thesis may provide some improvement to the process of evaluating land-use conflicts.

7.4.2 Economic Considerations

When comparing the relative merits of two or more competing land-uses, one criterion for evaluation is the economic value of each resource, for example forestry versus agriculture. Using some form of economic analysis, the main objective is to quantify the net present value of each land-use from the perspective of society. To effectively conduct a fair evaluation and comparison in economic terms, one must apply the same method of appraisal for each land-use and also apply similar measures of value. For comparisons involving forestry, the problem often becomes one of choosing what value to use. While other land-uses such as mining or agriculture may yield commodities with a market-determined price, the lack of similar prices for roundwood in many regions of the country is a constraining factor. Where stumpage prices are administratively set by government, or where they do not exist at all (as in pulpwood harvested by two mills in Newfoundland), deciding upon an adequate measure of value is difficult.

The net social value model is one approach to address the question of comparing equivalent values in land-use conflicts. A weakness in the model is the limitation to economic land-uses whereby a marketable commodity is ultimately produced from the resource extracted from the land. This restriction is necessary since the benefit side of the model is based on value added created through the extraction and processing (if any) of the resource. Therefore, land-uses such as recreation or wildlife cannot be directly compared with forestry or mining for example. While land-use conflicts with forestry and non-consumptive uses such as recreation do occur, these can in some cases be resolved through zoning or more appropriately by multiple-use land management. The main type of conflict to examine here is between single land-uses of an economic type which are not compatible. Thus, the model can be used to compare forestry with petroleum extraction, open-pit mining, agriculture and hydro-electric development. As long as data can be obtained on value added from potential resource use and public expenditures for maintaining the resource base, the third model can be used to conduct an economic comparison of alternative land-use.

7.4.3 Conflicts Between Forestry and Agriculture

Conflicts between forestry and agriculture are common in Newfoundland with solutions often being of a political rather than an economic nature. Therefore, agriculture is used in this policy example. The agriculture sector in Newfoundland is small when compared to forestry.[2] As an example, agriculture employs only about one-sixth as many people as forestry. The Island's short, cool growing season limits farm crops to mainly root vegetables. For these crops, there is very little secondary processing or packaging. Much of the annual harvest is sold directly from farmers to consumers. In terms of self-sufficiency, production of root crops satisfies approximately two-thirds of domestic demand. Animal and dairy products form the second component of the agriculture sector in the province. Major products include pork, chicken, eggs and milk. In terms of self-sufficiency, provincial production of animal and dairy outputs satisfies nearly 60 percent of domestic demand. For some products such as beef, the ratio of self-sufficiency is very low, in the order of two percent. In terms of exports, the agriculture sector makes virtually no contribution other than a small quantity of blueberries. Therefore, the leakage of provincial income to purchase imported agricultural products is relatively high. The provincial government has recently pursued a policy of expansion in the sector to increase domestic production of various farm outputs while also reducing the level of imports. To accommodate these goals, expansion of the area under crop or forage production has been encouraged. Thus, there has recently been a need for additional farm area. The conflict with forestry over land-use is becoming a major problem in certain regions of the province on unalienated Crown lands. The Avalon and Bonavista peninsulas are two such regions. In terms of commercial forestry, the latter region is the most important. The area supports a large sawmill industry and most recently has been providing pulpwood to one of the Island's newsprint mills. Conflicts over land-use tend to be centred upon small specific areas rather than based on the region as a whole. With this background an economic analysis can be conducted.

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[2] Information on the agriculture industry is drawn from (Economic Council of Canada,1977).

7.4.4 Economic Analysis; Forestry Versus Agriculture

To compare forestry and agricultural land-use within the scope of a specific local area, the most appropriate approach is to use a single hectare evaluation. In the case of forestry therefore, the analysis is not concerned with an average net social value per hectare based on the total growing stock, as in the protection example. Instead, one must focus the analysis on a single hectare of land and consider the net social value which will arise every rotation. Reforestation is assumed to be a normal public expenditure to maintain the resource flow over each rotation cycle.

There are three scenarios to examine. First, one can consider converting forest land to agriculture immediately after the final harvest. Second, one may examine the case of converting agriculture land to forestry. Third, the case of bare land without either forestry or agriculture in current production can be evaluated. For forestry, the derivation of net social value begins with cleared land; in the first case after commercial felling of timber; in the second case after agricultural production on essentially cleared land; in the third case with bare land. The net social value of one hectare of land under production of timber is calculated by (Equation 6);

$$V_0 = \frac{a}{(1 + i)^n - 1} \qquad \text{(Equation 6)}$$

where V_0 = capital value of the net social value
a = net social value per hectare of timber production
n = rotation period
i = discount rate

This formula essentially values the hectare of land based on the net social value "a", received every rotation "n", over an infinite series of rotations. Using data for the period 1977 to 1981 under a provincial accounting stance (Appendix 5), the average net social value per hectare, "a" is \$8954. The capital value of this net benefit, using an average rotation period of 60 years is:

$$V_0 = \frac{\$8954}{(1 + .075)^{60} - 1} = \$118 \text{ per hectare}$$

For agriculture, one can derive a rough estimate of net social value per hectare. For value added from agriculture in Newfoundland, data were available for the period 1978 to 1981 (Anon., 1981c). Also, for government expenditure on agriculture, data were on hand to the author for 1982 (Anon., 1983a). This figure ($8,995,741) was assumed to represent normal government expenditures for agriculture. To estimate expenditures for 1979 to 1981, the figure for 1982 was deflated by the GNE Implicit Price Index for government current expenditure on goods and services. Deducting these estimated annual expenditures from value added, and taking an average over the four year period (1979 to 1982), a net social value of $9,351,322 results. Based on a farm area of 22,633 hectares (crops, pasture and cleared unimproved farm land), a net social value per hectare is $413. To derive a present value, the simplest approach is to assume that the hectare of land will yield this net social value in perpetuity. Therefore, the capital value becomes:

$$V_0 = \frac{a}{i} = \frac{\$413}{0.075} = \$5507 \text{ per hectare}$$

To summarize, the capital value of forestry production (after harvest) is $118 per hectare while for agriculture, the capital value is $5507 per hectare. In the cases of bare land, or when contemplating a change from cleared agricultural land to forestry, these two figures would apply. Under these general circumstances, agricultural land-use is clearly more favourable using the criterion of net social value. In the case where one is converting from forestry use to agriculture, there will be additional development costs to bring the land to a cleared state such as stumping and breaking. No data were on hand for Newfoundland, however a recent study of land-use conflicts in Alberta (Bigsby, 1983) suggested these types of costs would be in the order of $200 per hectare. Even if these costs were ten times as great, they would not change the overall conclusion that on a per hectare evaluation agriculture land-use may be more favourable than forestry. An inescapable fact is that forestry is a victim of its long rotation period, yielding a merchantable crop every 60 years. While the net social value per hectare arising from agriculture at harvest is only one-twentieth that of forestry, the crucial point is that crops are produced annually with agriculture. The process of discounting places forestry at some disadvantage, however one cannot justify treating this resource differently from any other.

Modifying the discount rate or altering the net social value of each resource does not change the outcome. By using a real discount rate of only 1 percent for example, the net present social value per hectare for agriculture is $41300 compared to $10963 with forestry. One may compare more site specific values resulting from different harvesting yields. As an example, a site may produce higher than average timber volumes versus lower than average agricultural yields. This approach has limits however. One would need to double forestry yields (and hence net social value), halve agricultural yields and net social value, and use a 1 percent real discount rate to arrive at higher capital values per hectare for forestry. This situation is unrealistic for Newfoundland. First, if a site is conducive for higher timber yields (more fertile), a logical assumption is that agricultural yields would also be increased rather than reduced. Second, doubling forestry yields would require significant inputs of capital and labour after planting new stock. Treatments such as thinning or fertilization are discretionary investments which are not usually considered as normal costs of regenerating a forest to average stand volumes. Third, the use of a 1 percent real discount rate would find little support among most economists (Fraser, 1985).

The previous discussion reinforces the fact that in Newfoundland, the net present social value per hectare for agriculture is generally higher than forestry on a specific land area. This conclusion should not imply that agricultural land-use take precedence over forestry in all cases, or that agriculture is superior to forestry. The net social values are only one criterion for comparison. Others might include the creation of regional employment and income, or the potential for export earnings. As many different factors as possible should be examined by policy makers involved in land-use conflicts and resource allocation. However, the comparison using net social value suggests that the image of agriculture as a non-economic and insignificant industry can be challenged, at least in the Newfoundland context.

The net social value model provides a common framework to compare alternative land-uses which produce marketable commodities and thus some measure of value added. As a result, the model is limited to "economic" land-uses such as forestry or agriculture. However, the use of the model as one criterion for comparing alternative and conflicting land-uses, can provide improved information for policy-makers to act upon.

7.5 CASE 3. SILVICULTURAL INVESTMENTS

7.5.1 Background

A policy issue of increasing importance is the question of public investments to improve the forest growing stock. In Newfoundland, the evolution from extensive to a more intensive type of forest management began in the 1970's in response to two separate factors. First, the final report of the Federal-Provincial Task Force on Forestry in 1973 recommended a strong commitment to improved forest management in the province. In 1974 the provincial government passed legislation which strengthened its control over Crown forests and reorganized its Forest Service with a clear mandate for undertaking more intensive forest management programs. At the same time, the first in a series of five-year Federal-Provincial Forestry Subsidiary Agreements was signed, thereby directing greatly increased federal funding to the forest resource via the provincial government. Thus, funding was available to initiate more intensive forest management programs. The second factor of importance was the emerging awareness that the spruce budworm was causing considerable forest losses. By the late 1970's, this problem was a serious concern to both levels of government and industry. This concern also led to considerable pressure to increase the intensity of forest management in hopes of reducing or even avoiding future deficits in wood supply.

These events have provided the impetus for massive expenditures of public and to a lesser degree, private funds on improved forest management. Coupled with these expenditures have been questions of an economic and policy nature. One often recurring question is; how much money can be invested on a cleared site to justify the value of the future mature stand? An associated question is; how much money can be invested in a growing stand to increase future yields above normal stand volumes? A third question is related to the clearing of stands killed by the spruce budworm; how much expenditure can be justified compared to some measure of future stand value?

Answers to these questions are required to improve the planning and policy components of forest management, not only in Newfoundland but in all regions where forestry is a major economic activity. Funds are limited in the public sector. Over the past few years the provincial government has imposed severe austerity programs and budget restraint in the face of an increasingly depressed economy. Federally, the current atmosphere of restraint in public expenditure reflects concerns over the federal debt and the need to cut government costs. Therefore, a more effective rationalization of public investments in the forest resource, using economic criteria, is necessary.

7.5.2 Economic Considerations

In section 7.3, a capital value of the entire commercial productive forest growing stock on the Island of Newfoundland was estimated to be $1051 per hectare for 1986. This figure is the average net present social value for the forest as a whole and is based on the assumption that the forest will yield an even-flow of merchantable volume each year for industrial use over an infinite time horizon. The measure of social cost in the model is the sum of public expenditures incurred each year to maintain the forest resource base and related infrastructure. Some of these expenditures are for regenerating the forest on areas which are harvested. In Newfoundland, these expenditures cover a wide range of treatments such as scarification, planting, and seeding. Related costs include access roads and the provincial nursery. An implicit assumption of the net social value model is that each harvested hectare of productive forest is successfully regenerated and will yield a mature, commercial stand after one rotation. In this way, the forest growing stock will in theory provide an even-flow of harvestable timber under sustained-yield management.

If this condition is not completely valid, that is if each cleared hectare is not successfully regenerated, then over time, the forest growing stock will gradually decline in area and volume. Consequently, the AAC will decline, thus reducing the volume of timber available for industrial use. The net effect would be felt in decreased industry output and hence less value added produced in the economy. The reader may recall that the linkage between commercial wood production and forest sector value added was statistically weak for Newfoundland. However, this was felt to be due to the lack of significant change in wood production over time. As was shown in Finland, the linkage between the two variables is exceptionally strong, a relationship which intuitively should be so. Therefore, while the Newfoundland data do not support this relationship in statistical terms, one can assume that given a significant change in wood production and industrial output over time, value added would also change. Thus, the objective of maintaining the forest growing stock at current levels is important. This objective implies adequate regeneration of harvested areas plus any component of the commercial growing stock which has been lost to natural causes such as windthrow, fire, insects or disease.

One should recognize that alternative forest management strategies are available to maintain the level of growing stock over time and counter the effects of depletions caused by natural factors. Strategies include increasing the intensity of silviculture for stands currently growing (thinning or fertilizing), or by tightening utilization standards to force industry into harvesting more fibre from a given stand (smaller diameter limits, using branches, tops etc.). Nonetheless, one of the basic foundations of forest management in Newfoundland is the objective of reforesting cutovers, either through natural or artificial regeneration, or some combination of the two. Although no clear policy appears to exist in this regard and, while all cutovers are not automatically reforested, efforts are being made to increase the level of reforestation in Newfoundland. Therefore, the question of forest renewal is of primary concern.

7.5.3 Economic Analysis: Forest Renewal

In the case of cutovers, the central question is how much additional public expenditure, over and above current average expenditure levels, can be justified to ensure that a recently harvested site will yield a future volume of timber equivalent to the volume removed. While in theory, every cutover should be regenerated to the same standard, in practice this requirement can be relaxed. Some cutovers, for example those near to processing centres, can receive a higher level of inputs to ultimately produce a mature stand with volumes well above the average for the forest. On the other hand, some cutovers may receive less input, for example by the use of natural regeneration, which after one rotation may produce a mature stand with volumes below the average in the absence of thinning or other stand improvements. Rather than viewing each cutover separately, one should instead evaluate the aggregate of all cutovers each year in relation to the entire forest growing stock. The objective of forest management would then be to ensure that, on average, the sum of all cutovers each year will produce a mature volume of timber equal to the average forest volume per hectare. As an example, if the average stand volume at maturity for the entire growing stock is 100 m^3 per hectare, then the average future volume on recent cutovers should be at least 100 m^3 per hectare.

The analysis here is similar to the example of forest protection described in section 7.3. A failure to adequately regenerate an area of forest after harvesting effectively removes that area from the future growing stock in the same way as fire, insects or disease can reduce the area and volume of the forest. Therefore, the value at risk by failing to regenerate the forest cutover is $1051 per hectare. This is the average net present value per hectare based on the total productive, commercial growing stock on the Island for 1986 under both a provincial and national accounting stance. In another sense, this number represents the maximum surplus capital value of one hectare of the forest under consideration. Therefore, like the protection example, the maximum present value of public regeneration expenditures justifiable above the current normal average expenditure level is $1051 per hectare.

The case of rehabilitating budworm damage stands can be treated similarly. Public expenditures first to clear, and then reforest these areas can be limited to a present value of $1051 per hectare. The example can also be extended to thinning of naturally regenerated cutovers where such treatments are needed to ensure that future commercial volumes at maturity equal the average for the entire forest.

A logical extension of this concept is to include all public forest management expenditures which are a normal requirement for maintaining the forest growing stock and related infrastructure at current levels. Such expenditures include all forest management programs such as roads, research, clearing dead stands, reforestation, thinning naturally regenerated stands, protection etc. As an example, if initial planting efforts fail, the present value of any further silvicultural work required cannot exceed $1051 per hectare over an infinite series of rotations. If these treatments in effect "use up" a total of $1000, then future expenditures for additional forest protection or access roads etc., are limited to a capital value of $51.00 per hectare. For cutovers, the limit of $1051 per hectare allows a fairly wide scope for additional treatment to reforest the site to a standard which will ultimately yield commercial-sized mature stand volumes. As examples, thinning costs in Newfoundland are in the order of $400 to $500 per hectare, and planting, approximately $500 per hectare. Thus, after regeneration failure, additional public expenditures for a complete replanting and a thinning in the future could be justified.

For areas containing stands killed by budworm there is less scope for additional expenditures to bring these sites back into active production. To clear these sites, conduct some form of scarification, and undertake planting could cost in the order of $1500 per hectare. If these sites are viewed in isolation, such a level of expenditure cannot be justified. However, if these sites are aggregated with normal cutovers, then a certain area of this type of treatment can be warranted. The main point to remember is that overall, the average present value of all additional expenditures cannot exceed $1051 per hectare.

As a further example, assume that for a given forest growing stock, additional reforestation treatment is required on 20 hectares out of 40 which are cut. The average cost is an estimated $400 per hectare. Also, assume there is a large area of forest growing stock which is dead and requires clearing plus planting. The average cost is an estimated $1500 per hectare. The maximum area which can be cleared of dead trees and planted while keeping the level of additional costs for the whole forest below $1051 per hectare is 23 hectares. This figure is found by simple algebra:

1. 40 ha x $1051/ha = $42040 (maximum limit).
2. $42040 - (20 ha x $400/ha for cutovers) = $34040 (remaining)
3. $34040 divided by $1500/ha = 22.7 ha
4. Maximum area for stand clearing and planting which can be justified is 22.7 ha.

Therefore, the use of average capital values for the entire forest (in this case $1051/ha) may be applied to rationalize the area which can be subject to different types of treatments. If no cutovers required additional reforestation following initial treatment, then 28 hectares of dead stands could be treated.

Obviously, by using up the maximum surplus value of $1051 per hectare, one could not justify future public expenditures above normal levels on the sites aggregated each year, which in the example was 40 hectares of cutover and 23 hectares of salvage area. Thus, there would be no allowance for additional protection measures in the face of future insect threats. The $1051 per hectare is a guideline from which policy-makers must prudently allocate additional forest management expenditures to maintain the stock of forest capital at current levels.

7.5.4 Economic Analysis: Investments to Increase Forest Volumes

In the previous section, the analysis was based on the assumption that sufficient silvicultural effort would occur each year to ensure the maintenance of the forest growing stock volume over time. If initial reforestation efforts failed, or if losses to the forest resulted from natural causes such as fire, additional reforestation expenditures could be justified up to a maximum present value of $1051 per hectare. In Newfoundland, there is great concern over the adequacy of future wood supplies in the face of massive insect damage during the past 15 years. One might therefore argue that all current silvicultural expenditures are necessary to restore the forest growing stock to pre-damage levels. In terms of the model, these expenditures may be viewed as a normal cost of maintaining the forest resource and related infrastructure.

One question which can arise is how to evaluate silvicultural expenditures which are designed to increase future forest growing stock levels above current levels. While this opportunity may not exist in Newfoundland for some time in the future, it would be useful to examine the application of the model to this policy question.

Earlier in this thesis, a proposed use of the net social value model was to evaluate the economics of increasing the forest growing stock through expanded investment in silvicultural inputs. The underlying premise was that an increase in future AAC would allow a higher level of industrial activity under policies of sustained-yield management and hence increased value added. Using a simple regression, one could evaluate and compare future gains in forest volume and potential social value with the costs of increasing the forest volumes through a range of silvicultural treatments. As shown for Finland, this underlying premise is true. For Newfoundland, however, the data are such that a similar trend did not occur. Therefore, an evaluation of these types of forestry investments can only be conducted in a qualitative rather than a quantitative sense.

In Newfoundland, an initial step for policy-makers concerned with the forest resource is to assume that, as in Finland, major investments in resource expansion will yield future increases in net social value to the provincial and national economies. Government policy might therefore be aimed at the long-term goal of large increases in the forest growing stock. A specific goal might be to expand future AAC to allow a fourth paper mill to be built. Alternatively, a goal could be to expand the sawmill industry and reduce lumber imports by a certain percentage. These types of goals are only the first step in developing a long-term forest sector strategy in Newfoundland. Until the provincial government has the necessary tools and data base to make reasonable projections of future timber supply and demand, such a strategy cannot be properly formulated. Efforts are continuing in this regard, but successful results have not been achieved to date.

Assuming the necessary planning information becomes available, the net social value model is limited in its application to the development of long-term forest resource investment strategies. Using historic data, the model cannot predict the potential net social value resulting from current investments to increase forest capital. More importantly, the model cannot be used to determine what level of investment is justified by future gains in AAC and net social value. As an alternative approach however, one can make inferences about an expanded forest, based on the net social values derived for the existing forest. An assumption could be made that the net present social value of the expanded forest area will be at least equal in real terms, to the value of the original forest. However, these values will not accrue until the expanded forest is actually utilized. As an example, given a goal of expanding the forest to allow a fourth paper mill to operate in the future, the net social value of this forest will not arise until the stands are of merchantable size and used in production. Therefore, current investment costs can be compared with future capital values.

Using trend-line analysis for real net social values in Appendices 5 and 6 (1971 = 100), future projections can be made. For a simple example, projections are made to the year 2046 which is 60 years ahead of the base year, 1986. The 60 year period represents an estimate of the expected rotation age for managed softwood stands in Newfoundland. Thus, if we assume the expanded forest is achieved through some type of planting program, the net social value of this additional forest will not be available until the year 2046.

Under specific conditions, this time period could be reduced by using the allowable cut effect which was discussed in chapter 4. Given a certain level of old-growth stands in excess of current timber requirements and expanded efforts to increase the volume in younger age-classes, a fourth mill could begin operating before the 60 year rotation period for newly planted stands. As an example, instead of 60 years, the mill could begin production in 30 or 40 years by utilizing first the surplus volume of old-growth timber and then the younger stands as they mature. The reduction in time of 30 or 40 years would obviously allow the benefits of increased value added to be captured earlier. Thus, the present value of these benefits, discounted over a shorter time period, would be greater than those calculated over 60 years. However, the requirement of surplus mature volume may not exist in Newfoundland due to the effect of spruce budworm damage. Thus, in the following example, a 60 year time period is used.

Trend analysis equations are as follows, where Y is the real net social value (1971 = 100) and X is the future year 2046:

Provincial Accounting Stance

Value/m^3	:	$Y = 1.5191\,(X) - 2965.1815$
Value/ha	:	$Y = 157.9607\,(X) - 308326.5962$

National Accounting Stance

Value/m^3	:	$Y = 1.6669\,(X) - 3260.1923$
Value/ha	:	$Y = 173.3385\,(X) - 339031.1432$

Real net social values in the year 2046 are:

Provincial	:	\$143/m^3	or \$14861/ha
National	:	\$150/m^3	or \$15619/ha

The use of values per m^3 is more appropriate since the future managed stands will likely contain higher volumes than in current natural stands. As the reader may recall, the net social values per hectare for current stands were based on average stand volumes during the period of study. The use of area values for managed stands would therefore be an underestimate. For the provincial value of $\$143/m^3$, the present value in 1986, discounted by a real rate of 7.5 percent over 60 years is $\$1.87/m^3$. Thus, for every incremental m^3 in future volume, the provincial government can justify an expenditure of \$1.87. If, for example a hectare of this incremental forest was estimated to yield 300 m^3 at maturity, a maximum public expenditure of \$561 would be justified. At the national level, both levels of government could justify a combined expenditure of \$587 per hectare. A similar approach can be used to evaluate investments in forests already growing, through thinning or fertilizing, to increase future yields. This type of analysis is based on the assumption that the net social values over time will increase in real terms as was derived from the study period. This assumption is in all liklihood valid, however there is no method to test it. In any event, the approach described in this section provides a simple method to rationalize major public investments in forest capital which will yield significantly large increases in the future volume of the forest growing stock.

7.6 CASE 4. GOVERNMENT FUNDING POLICY

7.6.1 Background

Over the past decade, government funding to the forestry sector at both the provincial and federal levels has increased greatly. In Newfoundland, more than \$100 million in public funds has been channelled to the forestry sector since 1974. During 1986, a further \$50 million is expected to be allocated over a similar time period. Throughout the country, governments have committed themselves to approximately \$1 billion in forestry expenditures over the next five years. The main vehicle for these expenditures is a federal-provincial cost-shared forestry agreement, better known as a Forestry Subsidiary Agreement. In Newfoundland, the first two Agreements operated on a 90/10 federal-provincial cost-sharing ratio. Programs under these Agreements have included virtually every aspect of forest management carried out by the provincial Forest Service such as inventory, silviculture, access roads, protection and forest products development. The new Agreement currently under negotiation will likely continue funding this type of program although a 70/30 federal-provincial cost-sharing ratio is expected.

These Agreements are geared primarily towards maintaining the forest resource base and related infrastructure in the province of concern. Whether these Agreements will continue into the 1990's is of course impossible to predict. However, there are two main policy issues to consider in view of future Agreements in all provinces. First, how should federal funds be allocated among all the provinces? Public funds are limited. For federal funds earmarked for the forestry sector, can the net social value model be used to compare different provinces and rank them in some order of priority? A second policy issue is important at the provincial level. Assuming that a given amount of federal funds has been allocated to one province for forestry use, what should the provincial (and industry) contributions be? Can the net social value model be used to assist in determining an equitable cost-sharing ratio for the Agreement under negotiation? Answers to these questions will provide improved information to both federal and provincial officials involved in policy at a senior level and facilitate more effective Agreement planning.

7.6.2 National Funding Policy Application

There are two means by which the net social value and supporting data could be used to develop a provincial ranking system. The first approach is to compare the net social value per m^3 for each province. In general, a higher value would infer a greater net contribution to the national economy. Thus, a province with a net social value of \$100 per m^3 would rank higher than a province with a value of \$80 per m^3. A second approach is to calculate a benefit-cost ratio from the value added and public expenditure data. A higher ratio would imply a greater contribution to the national economy per dollar of public expenditure. In this manner, a province with a value of 10 would rank higher than a province with a value of six.

In making these comparisons, a few points of precaution must be considered. First, the nature of the data base should be clearly understood. The value added data reflect a difference between the value of product (measured by price) and the costs of specific production inputs. Thus, a province with an industry dominated by high value added production (paper products versus lumber) will tend to have a higher value added per m^3 of roundwood used. Also, one should recall the nature of the net social value figure itself which is simply the difference between total industry value added and total government expenditure on maintaining the forest resource base and related infrastructure. Under a national accounting stance, both federal and provincial government expenditures are included. Thus, the level of annual expenditure can greatly influence the net social value per m^3 or benefit-to-cost ratio. If expenditures per m^3 of roundwood consumed in one province are lower than in another, given the same industry structure, this difference in expenditure will be reflected in the net social value per m^3. As an example, the cost of building access roads in mountainous regions such as British Columbia or Alberta, will be higher than in other provinces with flatter terrain. Therefore, any comparisons using net social value or a benefit-cost ratio must also include an examination of value added and government expenditure on a per m^3 basis.

With the provinces ranked in order of priority using the net social value per m^3 and/or a benefit-cost ratio, there are two possible options for funding allocation at the national level. Each option depends upon the economic goals and associated policies of the national government. The first option would follow from a government goal of maximizing the economic returns from each dollar spent in the forestry sector of any province. Thus, a province with a high net social value per m^3 and benefit-to-cost ratio would receive priority for continued funding from the federal government. Conversely, those provinces with lower values would be ranked less favourably.

The second approach takes the opposite view, that is provinces with low rankings should receive funding priority. The policy objective here is to gradually increase the net social value per m^3 over time through a short-term increase in government expenditure. These expenditures would have to provide the catalyst for increasing industry value added per m^3 of roundwood used. For the forest resource itself, expenditures might be aimed at increasing future forest volumes nearer to processing centres, thereby reducing long-term industry transportation costs. For the processing sector, industry value added could be increased by providing funds to improve technology and thus reduce manufacturing costs. Also, funds could be directed towards programs for increasing the level of processing to higher value added products. For example, adding furniture or roof-truss manufacturing to the lumber industry would increase the total value added per m^3 of roundwood harvested. Also, the opportunity to expand a pulp industry into newsprint, fine papers and other similar products would achieve the same effect. These types of expenditures by the federal government would involve several line departments. Thus to embark on a program of increasing industry value added over time would require coordinated departmental planning and operations. This second approach to federal funding must also include a broad analysis of industry potential in each province. Some provinces with a low ranking in priority may be constrained from expanding output or undertaking large changes in technology. For example, there may be constraints in the supply of non-wood production inputs (labour, power, water, etc.), poor access to export markets, conflicts with provincial government development policies etc. which preclude effective increases in forest sector value added using federal funding.

As shown, each approach for allocating federal funds to the forestry sector in different provinces can use the net social value model and supporting data. Each approach has merit, however one should recognize that funding decisions are within the political domain and subject to political influence. It is highly unlikely that the model will be used by politicians to determine an appropriate allocation of funds among different provinces. The main use of the model can be effected by senior government officials and advisors to politicians. The model can provide some guidance as to the percentage of available funding each province could receive based on provincial contributions to total national net social value. In this way, reasonable limits to funding for any province can at least be illustrated.

One should also recognize that other criteria are important in funding decisions at the national level. These criteria include comparisons of the various economic benefits generated by the forestry sector in different provinces, for example employment and contribution to national export earnings. Also, such interprovincial comparisons should take account of the absolute value of economic benefits. As an example, in comparing British Columbia and Prince Edward Island, the former province must take priority in funding given the scale of its industry. A more effective comparison, and one where the model can be used to advantage is in comparisons of provinces with a similar-sized industry and structure, such as Manitoba, Saskatchewan and Newfoundland. This policy application cannot be rounded out with an actual example since the detailed data required were collected for Newfoundland only.

7.6.3 Provincial Funding Policy Applications

When considering the prospect of continued government funding for the maintenance of the forest resource and related infrastructure through Forestry Subsidiary Agreements, a point of debate is the selection of a cost-sharing ratio. Given a specific level of federal funding allocated for forestry expenditure in one province, what should the provincial government contribution be? Also, if industry is involved in a future Agreement as a third party, what should its contribution be? In theory, the contribution, or expenditure by each party in an Agreement should equal the ratio of benefits received. In the context of the net social value model, effective policy application depends upon separating the net social value, or the supporting data into the desired components of government and (if needed) industry.

As an initial step, the reader should recall that net social value in the model is the difference between industry generated value added through utilizing the forest resource, and government expenditures made to maintain the resource and related infrastructure. Social benefits are represented as value added created by the forest industry, and is a measure of the economic activity generated by forestry. Social costs are represented by the government forestry expenditures. Thus, the model views industry as an exogenous variable. Since industry costs are not included in the model one cannot separate the net social value into industry and government components. While public benefits and cost are represented, only industry benefits are included as the profit component of value added. Therefore alternative approaches are required to address the problem of determining the share of benefits received by industry and government.

One approach is to concentrate solely on value added. Industry's share of value added is represented by the profit component. Thus, by knowing the total profit earned by industry, dividing this figure into total value added would yield an estimate of industry's share of value added, or the benefits received. If for example this worked out to 15 percent, averaged over a specific period of time, one might argue that industry's share of expenditures in a new Agreement should be of a similar amount. To follow this approach requires that published data on industry profitability be available for every province. Unfortunately, this may be difficult in practice. Statistics Canada publishes before- and after-tax profits for many industrial sectors, but some provinces are excluded in order to preserve confidentiality. Also, the data refer only to manufacturing, that is wood industries and paper and allied industries. The logging sector is excluded. Therefore, this approach is unfeasible.

An alternative approach might be to use a Canadian average of profits divided into value added. One would have to assume that this percentage reflected the situation for logging firms. As well, the average would be assumed to represent the situation in all provinces. Such an average would mask regional variations in industry profitability due to differences in cost structures, product lines, market areas and general competitiveness. However, despite this fault, a Canadian average would provide an initial guideline figure from which industry and government could negotiate. Using published data on forest industry profits and value added in Canada (Anon., 1985c), an average value of profits divided into value added for the years 1977 to 1981 was 22.7 percent. An updated figure using more recent data could be used as a guide for negotiating industry's contribution to forest resource expenditures in a new Agreement. As an example, if both levels of government negotiated an Agreement for $100 million over five years, an industry contribution of nearly $30 million, added to the government sum, would represent 22.7 percent of total funds available. If industry expenditures on forest management were near this level already, a formal Agreement would not change the status quo. On the other hand, wide variations from this guideline in either direction would undoubtedly provide a point for discussion between senior industry and government officials in the context of forest policy.

One valid criticism of this approach is that some or all of the industry's share of value added represents a benefit to society as a whole. The after-tax profits of any firm or corporation can be split, a portion of which are retained by the business for reinvestment, the remainder distributed to working owners and shareholders. For profits reinvested in the business, all expenditures made within the country represent some form of economic activity through the purchase of goods and services. These economic benefits accrue at the provincial and national level. Only expenditures which leave the country to foreign companies are not a benefit to Canada. For distributed earnings, these monies represent income to the individuals receiving them. A portion of this income will be spent on goods and services, thus increasing economic activity. Earned income which leaves the country to foreign owners is a loss of social benefits to Canada. In theoretical terms, using an average percentage of industry profits from total value added as a guideline for negotiating industry's share of forestry expenditures may be inequitable. In practical terms, measuring the flow of industry profits in various directions (reinvestment, expenditures in and out of Canada, earnings paid to resident and non-resident owners etc.) would be extremely difficult. If one views profits in a general sense, then they can be seen as representing industry's share of value added. However, a more rigorous view of profits, which recognizes their contribution to economic activity, indicates that the percentage of profits from total value added cannot be used to represent the industry's share of value added.

Equally difficult is the idea of separating value added into provincial and federal components for use in developing cost-share ratios in Forestry Subsidiary Agreements. Conceptually, one must accept the fact that social benefits in any one province are also social benefits to the country as a whole. Thus, the generation of value added in Newfoundland is of benefit to the Canadian economy as well. In practical terms, one might attempt to trace the distribution of value added created from forestry activity. As discussed previously, industry profits may be distributed within Newfoundland, throughout Canada and to other countries in the world. The same pattern can occur for the interest and depreciation portion of value added. Labour income is a major component of value added. In Newfoundland, labour income comprised an average of 50.3 percent of value added in the forest industry over the period 1967 to 1981. Initially, all labour income is paid to workers in Newfoundland. This income is then either saved or spent, and a portion is taxed by both levels of government. For the income spent, a certain amount will leak out of the economy either directly or later, through secondary expenditure. Tracing the pattern of employee expenditure and the distributional effects can be estimated through survey techniques or input-output tables. While these methods are prohibitively expensive to repeat on an annual basis, the distributional trends in income are not likely to change from year to year. Thus, given initial data, estimates in future years are possible.

The overall conclusion must be that net social value or value added cannot be used to determine the cost-share ratio of funding Agreements between industry and both levels of government. These economic criteria can only be applied to policy applications in whole; they cannot be separated into various components accruing to different parties. Cost-sharing ratios will therefore, remain dependent upon political influences and, negotiations between governments and industry. Other criteria could be used, for example the second model of net income based on public revenues; however this is a decision to be made by policy-makers alone.

7.7 SUMMARY OF CHAPTER 7

In this chapter, applications of the net social value model to important policy questions were provided. Initially, the role of policy was discussed in the overall context of the decision-making process. Policies can only be developed after goals are established and alternative strategies evaluated. To assess how well a chosen course of action and associated policies have reached the desired goals of society, evaluation of results is necessary. In this regard, adequate measures of social values are required. Clearly for forestry, such values are not presently used in decision-making in Canada. Thus, the net social value model is seen as an important contribution to improving this deficiency. The role of discounting in policy analysis and program evaluation was discussed and a discount rate selected for use in the actual examples. A real discount rate of 7.5 percent was chosen as a compromise between the two alternative theories of social time preference and social opportunity cost, each having a long list of supporting studies.

Four key policy applications of the net social value model were conducted, using Newfoundland as an example. In the case of forest protection, the average net present social value of Newfoundland's commercial, productive forest was estimated to be $1051 per hectare for 1986. This figure represents the values at risk from failing to provide increased protection in the face of a severe forest threat such as an insect epidemic. As well, the $1051 represents the maximum present value of increased protection expenditures which can be justified by government.

The second policy example considered the problem of local land-use conflicts, primarily between commercial forestry and agriculture. On an individual hectare basis, agricultural use has the higher net present social value. The difference is so great that increasing the harvest yields of forestry or reducing the discount rate makes no change to the ranking. As pointed out, these results should not imply that overall, agriculture is better than forestry. Other criteria for comparison may alter the ranking. The results do suggest however, that the potential economic contribution of agriculture may be significant.

The third policy application related to the whole question of forest renewal and increased investment in forest capital. For the renewal case, the average net present social value of $1051 per hectare was viewed as the maximum level of government expenditure which could be justified to ensure that forest volumes are maintained. This concept applies to all forest management activity including reforestation, stand rehabilitation and protection. For assessing investments to increase, rather than maintain the forest growing stock, government expenditure in the range of $1.87 to $1.95 per m^3 of future volume can be justified at present.

The final policy question examined was the issue of government funding to the forestry sector, mainly through Forestry Subsidiary Agreements or similar funding arrangements. At the national level, the net social value model can be used as one criterion for comparing the potential for federal funding among different provinces. Two approaches can be followed, depending upon the policy aims of the government and more importantly, the politicians making the actual decisions in Cabinet. Funds can be directed on a priority basis to provinces with the highest net social value per m^3, or alternatively to provinces with lower values in order to increase these to a national average. In either approach, the model can provide guidance as to what level of funding is appropriate using economic criteria.

At the provincial level, the model cannot be used directly to determine a cost-sharing ratio between industry and both levels of government based on relative shares of net social value or value added. Overall however, the model can be used successfully in many key areas of policy development and analysis. By providing improved information on forest resource values, the process of decision-making in the forestry sector will be advanced.

8.0 CONCLUSIONS AND RECOMMENDATIONS

In this study, the problem of inadequate forest resource values was identified as a serious constraint on the development of forest sector policy by government agencies in Canada. Currently, most analysts use stumpage prices as the measure of value for forest resources utilized in commercial production. One important conclusion of this study was that stumpage prices in Canada fail to reflect the full value of commercial timber to both government and more broadly, society as a whole.

The concept of value was defined as a continuum, with net social benefits representing the optimum measure of value at one end point. In theory, this point is reached by measuring all benefits and costs incident upon society from a proposed project or ongoing program. As one departs from this point, for example when using values determined by market prices, political processes, judicial decisions, or some combination of these, the measure of value becomes less than optimum. In Canada, most provinces continue to use stumpage prices which are either negotiated between industry and government, or arbitrarily determined by government alone. While recognizing that these stumpage prices are poor measures of social value, the conclusion was also made that this fault would exist with timber prices determined through competitive markets.

Rather than wrestling with the question of what stumpage prices might be under different conditions, or what these prices should be in order to capture full economic rent, this study sought to develop an alternative measure of value. The overall objective was therefore to ignore the whole stumpage issue and instead concentrate on deriving a measure of value which reflected the net benefits of forestry activity incident on government and society as a whole. Given the large scale of public forest resource ownership and management control in Canada, an urgent need was identified for a measure of value which governments could use in internal policy development.

To address this need, three alternate models of resource valuation were derived, based on the principle of value-in-use. The underlying foundation is the fact that benefits to the economy and thus society as a whole arise from the harvesting and processing of commercial timber by the forest industry.

The first model equated the level of benefits received from commercial resource use with the level of government expenditure on maintaining the forest resource base and related infrastructure. The rationale for this model is that by continually committing expenditures in this manner, the society on whose behalf the government acts, must be signalling that the resource is indeed worth as much as these expenditures.

The second model was based on the principle of net benefits. In this case, benefits from resource harvesting and processing were represented by public revenues paid by the forest industry. Costs were represented by government expenditures on maintaining the forest resource base and related infrastructure. Deducting expenditures from revenues yielded a measure of net resource value. Both the first and second models use a provincial and federal accounting stance to reflect the fact that benefits and costs from commercial timber production are incident upon both levels of government.

The third model provided a partial estimate of net social values arising from commercial timber production. Social benefits were represented by forest industry value added while social costs were the same government expenditures as in the first two models. The third model used a provincial and national accounting stance since net social values from forestry benefit both provincial and national economies. For all three models, resource values were produced on both a unit timber volume and unit forest area basis.

The third model was judged to be the best of the three, based on four criteria:

a) the theoretical basis of the model in terms of the optimum measure of value, net social benefits,
b) the practical basis of each model in its ease of understanding and the availability of required data,
c) the statistical characteristics of the time-series data base used in deriving the estimates of value for each model, and
d) the extent to which the model could be used in addressing current policy issues in the forestry sector.

The third model was then used in more detailed policy applications in Newfoundland. Four current policy issues were addressed :

a) forest protection,
b) land-use conflicts,
c) silvicultural investments,
d) government funding of forestry.

The net social value model was found to be an important tool in each of these policy issues. The net present social value of the Island's total commercial, productive forest resource was estimated to be \$3.8 billion in 1986. On a unit basis, this value is \$1051 per hectare, or \$22 per m^3 based on an area of 3,659,000 hectares and a growing stock of 174 million m^3. In terms of forest protection, the value at risk of \$1051 per hectare indicates that a wide scope exists for increasing forest protection expenditures above the usual recent levels in the face of a serious threat such as a major insect outbreak.

With forest renewal, the net present social value of \$1051 per hectare establishes a limit for public expenditure to maintain the long-term productivity of the resource base. Taking a broader view, this value is a maximum limit to public expenditure for all management inputs to maintain the resource base and AAC. The model can also be used to guide public expenditures aimed at increasing the volume of forest growing stock and AAC. As an example, the provincial government in Newfoundland would be justified in spending an estimated \$1.87 for every incremental m^3 increase in future forest volumes using planting or seeding programs, and assuming a real discount rate 7.5 percent.

For land-use conflicts, the model was used to compare forestry and agriculture under the single, equivalent criterion of net social value. The results indicated that on a specific hectare of land and under the study's assumptions, agricultural use offers a higher return than forestry in Newfoundland. Although additional criteria could be evaluated, the results suggest that agriculture should receive more serious consideration as an economically viable land-use option.

The model was also shown to have useful applications to government funding decisions and associated policies at the national level. The model could be used by the federal government to rank each province according to net social value. In this manner the model could offer guidance on the priority of funding among the various provinces. At the provincial level the model could not be used to determine an equitable cost-sharing ratio for funding agreements between industry and both levels of government. However, since the model provides the means of establishing limits to public expenditure, cost-shared funding programs could be more effectively negotiated by government.

Clearly in the case of Newfoundland, the net social value model can be an important analytical tool for decision-makers by providing improved information on forest resource values. In assessing the overall merits of this model however, one must consider the scope for applications outside Newfoundland. As discussed in the thesis, the model can be used for any province since the majority of required data are available from Statistics Canada publications. Other data such as provincial government forestry expenditures can be procured from public accounts information or reports compiled by individual departments.

Outside Canada, the model should have useful applications in forest policy in most countries. As long as data are available on industry value added and public forestry expenditures, a net social value can be linked to the resource base. Even in countries where private forest ownership is dominant, for example in Finland, the model can provide government with estimates of value-in-use. As an extreme case, let us consider a small nation where all forests are privately owned by one large firm which also owns all processing capacity. The single company harvests and processes its own wood. There is no market in round timber, and the government receives no stumpage or royalty. In this situation, government officials will have no timber prices, and hence no resource values to use in policy analysis. However, the net social value model can provide a measure of resource value. The fact that forest land is privately owned is irrelevant; timber harvesting and processing still generate value added into the national economy. If public expenditures are made to maintain the resource base and related infrastructure, then a net value results from deducting these from value added. Given that the model can be used in most countries (limited only by data availability), policy applications at the global level are possible. Agencies like the World Bank or FAO for example could rank different nations according to the net social value of their forest resources. These values would provide information to decision-makers, in addition to other criteria, for use in the development of international aid or funding policies.

Outside the sphere of forestry, the model has potential applications for the evaluation of many resources which generate value added. If one is solely concerned with aggregate net social value at the macro-level, a wide range of resource sectors can be evaluated, such as forestry, agriculture, mining, fishing and trapping. To compare similar sectors among different regions (e.g. mining in each province), unit values could be developed in a similar manner to forestry. Thus, one might compare fishing between regions in terms of net social value per tonne of fish. For intersectoral comparisons such as fishing versus mining, only total aggregate net social values can be used since each sector has a different base unit. The exception is agriculture and forestry where comparisons on an area basis can be made.

As shown, there are further opportunities to apply the model in policy development and analysis, both within Canada and in other nations. Therefore, one clear recommendation for future research is in this area of policy application. An associated research objective must also be to refine further and improve the data base used in calculating net social value. Initially, this research might concentrate on forestry within each province in Canada. However, this research could then be expanded to include other resource systems. Another recommended area of research is in quantifying non-timber costs and benefits which arise through commercial harvesting and processing of forest resources. This is a difficult area of research and one that has constrained resource economics for some time. Nonetheless, research in this field should continue to receive attention by economists. A further area of research is to develop an econometric model to predict changes in net social value, or value added alone, using a multiple regression approach with several variables in addition to wood production. Such a model would be extremely useful in long-term forest sector planning.

Overall, the net social value model provides decision-makers with an improved measure of resource value for use in the development of internal government policy. For specific policy analyses within one region such as evaluating public expenditure on forest protection or renewal, the model is a powerful tool. Where regional or intersectoral comparisons are being made, however, the model only provides one criterion for evaluation. This limitation should be recognized. Additional criteria for comparison such as employment or foreign exchange contributions would usually require consideration and might be incorporated into a comprehensive analysis.

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APPENDIX 1

Provincial Government Forestry Expenditures

1. Calculation of total annual expenditures

Year	Forestry Dept. Expenditures[1] ($)	Percentage of Total Administration Costs (%)	Share of Administration Costs ($)	Total Provincial Government Expenditures On Forestry ($)
1967	2,756,024	0.496	140,075	2,896,099
1968	2,962,299	0.518	125,442	3,087,741
1969	2,818,835	0.500	127,268	2,946,103
1970	1,495,489	0.463	126,573	1,622,062
1971	2,657,311	0.450	156,330	2,813,641
1972	3,378,134	0.489	216,085	3,594,219
1973	3,786,819	0.500	217,981	4,004,800
1974	3,943,471	0.500	366,801	4,310,272
1975	5,101,015	0.500	405,490	5,506,505
1976	5,195,977	0.547	691,129	5,887,106
1977	5,615,557	0.594	785,414	6,400,971
1978	6,175,560	0.589	922,161	7,097,721
1979	8,407,992	0.827	1,265,215	9,673,207
1980	8,410,551	0.829	1,315,688	9,726,239
1981	10,401,450	0.814	1,458,281	11,859,731

[1]Source: Public Accounts, Government of Newfoundland and Labrador 1967 to 1981.

-Includes salaries,operating expenses, capital purchases for infrastructure, inspection of logging camps.

-Excludes grants to Newfoundland Forest Protection Agency, Maritime Lumber Bureau, Canadian Council of Resource and Environment Ministers, Eastern Spruce Budworm Council, and Association of Canadian Universities for Northern Studies; contributions to Gros Morne National Park; capital funds to Labrador Linerboard.

2. Estimated provincial government forestry education expenditures.

Year	Expenditures[1] ($)
1967	36,087*
1968	42,415*
1969	48,742
1970	62,381**
1971	76,019**
1972	89,658**
1973	103,296**
1974	116,935
1975	144,836
1976	158,997
1977	171,059
1978	179,407
1979	206,437
1980	229,129
1981	256,827

[1] Source: Estimated by applying 0.06 percent share of forestry-related education expenditure to total provincial education budget.

* Published data on total provincial education budget not available to author. Estimates for 1967 and 1968 calculated by assuming linear expenditure increases from 1964 ($17,106) to 1969 ($48,742) where published data on total expenditures were available.
Equation of line; $Y = \$6327.2(x) + \$17,106$.

** Same approach as above, but using intervals of 1969 and 1974.
Line equation; $Y = \$13,638.6(x) + \$48,742$

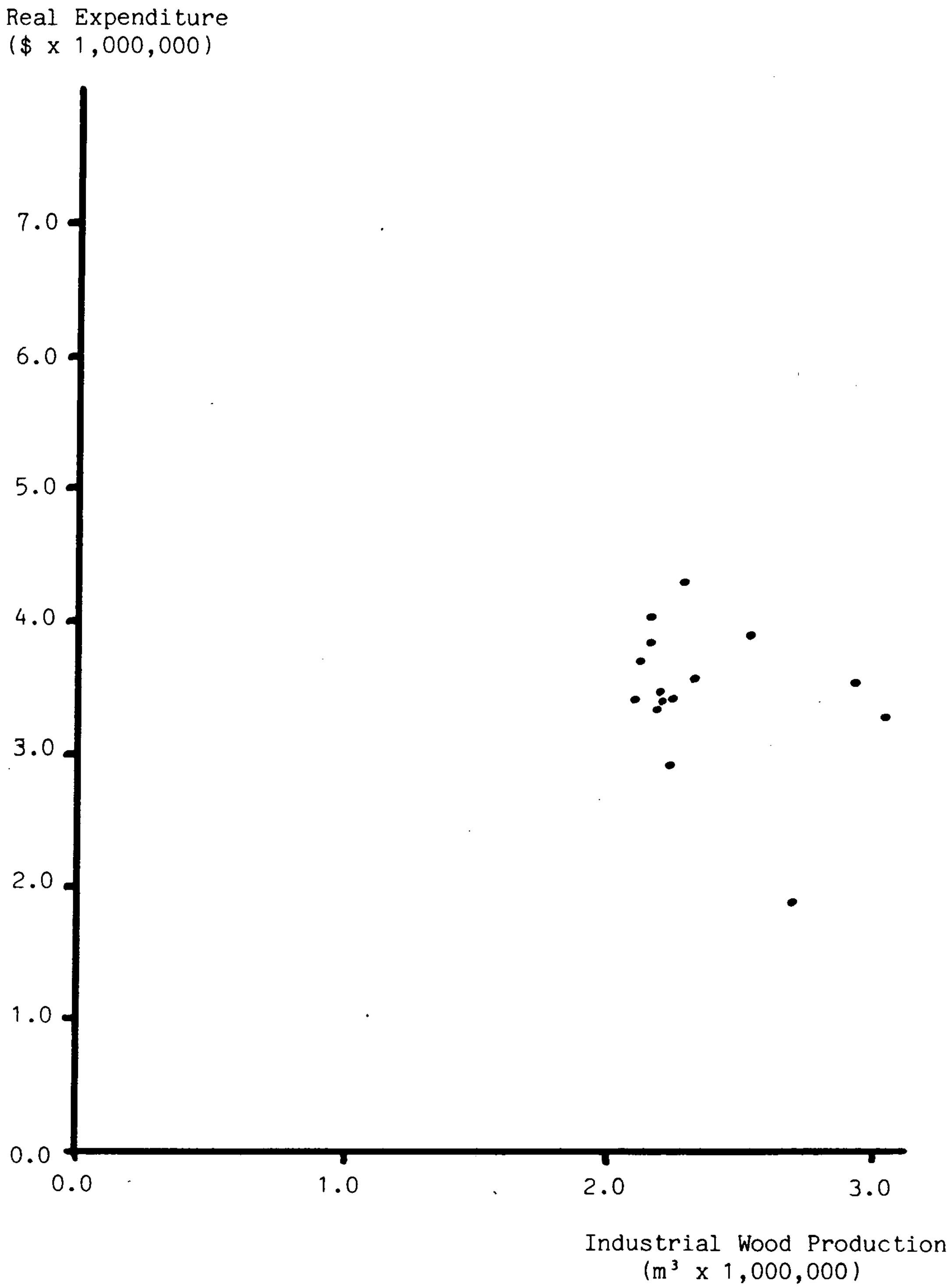
3. Calculation of real expenditures

Year	Nominal Expenditure[1] ($)	Implicit Price Index[2] 1971 = 100	Real Expenditure ($)
1967	2,932,186	77.8	3,768,877
1968	3,130,156	82.2	3,807,976
1969	2,994,845	89.0	3,364,994
1970	1,684,443	94.2	1,788,156
1971	2,889,660	100.0	2,889,660
1972	3,683,877	107.2	3,436,452
1973	4,108,096	116.4	3,529,292
1974	4,427,207	135.1	3,276,985
1975	5,651,341	156.0	3,622,654
1976	6,046,103	177.4	3,408,175
1977	6,572,030	194.5	3,378,936
1978	7,277,128	210.7	3,453,786
1979	9,879,644	229.8	4,299,236
1980	9,955,368	260.0	3,828,988
1981	12,116,558	295.6	4,098,971

[1]Source: Sum of provincial government forestry expenditures from sections 1 and 2 of this appendix.

[2]Source: Statistics Canada, Catalogue 13-201, Annual. National Income and Expenditure Accounts. The index is the GNE Implicit Price Index, Government current expenditure on goods and services.

4. Real provincial forestry expenditure vs. industrial wood production.



5. Statistical analysis of data

a) Real expenditure

1.	$\bar{x}$ Value ($)	3,463,543
2.	Range ($)	1,788,156 to 4,299,236
3.	Standard Deviation	577,497
4.	Coefficient of Variation (%)	16.67
5.	Average Annual Increase (%)	3.01

b) Nominal expenditure

1.	Average Annual Increase (%)	12.62

c) Regression between industrial wood production and real government expenditure, where,

x = wood production
y = real expenditure

Equation of regression: [y = -0.6875(x) + 5,075,883]

$r = -0.35$
$r^2 = 0.12$

Test of significance for r :

H_0 : The correlation coefficient r in the population is not significantly different from zero.

H_1 : The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero up to 0.20 level of significance. Reject H_1, Accept H_0.

6. Provincial government expenditure per m^3 and per ha

Year	Expenditure Per m^3 (\$)		Expenditure Per Ha (\$)	
	Nominal	Real	Nominal	Real
1967	1.40	1.80	145.35	186.83
1968	1.45	1.76	150.58	183.18
1969	1.38	1.55	143.67	161.42
1970	0.62	0.66	64.83	68.83
1971	1.33	1.33	138.75	138.75
1972	1.66	1.55	172.35	160.77
1973	1.46	1.26	152.04	130.62
1974	1.44	1.07	150.17	111.16
1975	2.41	1.54	250.31	160.46
1976	2.70	1.52	280.97	158.38
1977	3.11	1.60	323.62	166.38
1978	3.34	1.59	347.49	164.92
1979	4.38	1.91	455.85	198.37
1980	3.94	1.52	409.89	157.65
1981	5.70	1.93	592.44	200.42

7. Moving average calculations $/m^3-real data

	Time Period of Moving Average			
	3 year	5 year	7 year	9 year
	1.70	1.42	1.42	1.39
	1.32	1.37	1.31	1.36
	1.18	1.27	1.28	1.34
	1.18	1.17	1.28	1.35
	1.38	1.35	1.41	1.49
	1.29	1.39	1.45	1.51
	1.29	1.40	1.50	1.55
	1.38	1.46	1.54	
	1.55	1.63	1.66	
	1.57	1.63		
	1.70	1.71		
	1.67			
	1.79			
$\bar{x}$ Value ($/m^3)	1.46	1.44	1.43	1.43
Standard Deviation	0.21	0.16	0.13	0.09
Coefficient of Variation (%)	14.38	11.11	9.09	6.29

APPENDIX 2

Federal Government Forestry Expenditures

1. Federal research expenditures in Canada

Year	Canadian Forestry Service Operations ($)[1]	Grants and Contributions to Other Agencies ($)[2]	Total ($)
1968	22,000,000	160,000	22,160,000
1969	21,600,000	160,000	21,760,000
1970	22,300,000	160,000	22,460,000
1971	22,600,000	160,000	22,760,000
1972	31,200,000	160,000	31,360,000
1973	33,600,000	160,000	33,760,000
1974	36,500,000	160,000	36,660,000
1975	36,800,000	289,000	37,089,000
1976	35,400,000	1,289,000	36,689,000
1977	37,600,000	1,289,000	38,889,000
1978	40,800,000	2,439,000	43,239,000
1979	39,300,000	6,539,000	45,839,000
1980	43,400,000	7,939,000	51,339,000
1981	46,200,000	9,739,000	55,939,000

[1] Source: (Solandt, 1979) and information from CFS, Ottawa. Figures include expenditures on capital, salaries, operations.

[2] Source: (Anon. 1984e). Figures include contributions to ENFOR, FORINTEK, FERIC and University forestry schools.

2. Federal government forestry expenditures in Newfoundland

Year	Resource Expenditures ($)[1]	Research Expenditures ($)[2]	Total Expenditures ($)
1968	708,347	918,754	1,627,101
1969	684,558	902,170	1,586,728
1970	655,647	931,192	1,586,839
1971	663,365	943,630	1,606,995
1972	312,588	1,300,186	1,612,774
1973	697,817	1,399,690	2,097,507
1974	1,904,761	1,519,924	3,424,685
1975	8,710,832	1,537,710	10,248,542
1976	7,854,905	1,521,126	9,376,031
1977	9,081,155	1,612,338	10,693,493
1978	4,373,790	1,792,689	6,166,479
1979	4,438,050	1,900,485	6,338,535
1980	5,330,621	2,128,515	7,459,136
1981	9,076,095	2,319,231	11,395,326

[1] Includes inventory expenditures to 1974; after 1974 contributions to Forestry Subsidiary Agreements are included. Sources: Public Accounts, Government of Newfoundland and Labrador; Evaluation Committee Reports (1981, 1983, 1984). Expenditures do not include contributions to Labrador Linerboard mill.

[2] Calculated by dividing total federal research expenditures in Canada (Section 1 of this appendix) by the percentage of inventoried productive forest in Newfoundland compared to Canada (4.146 percent).

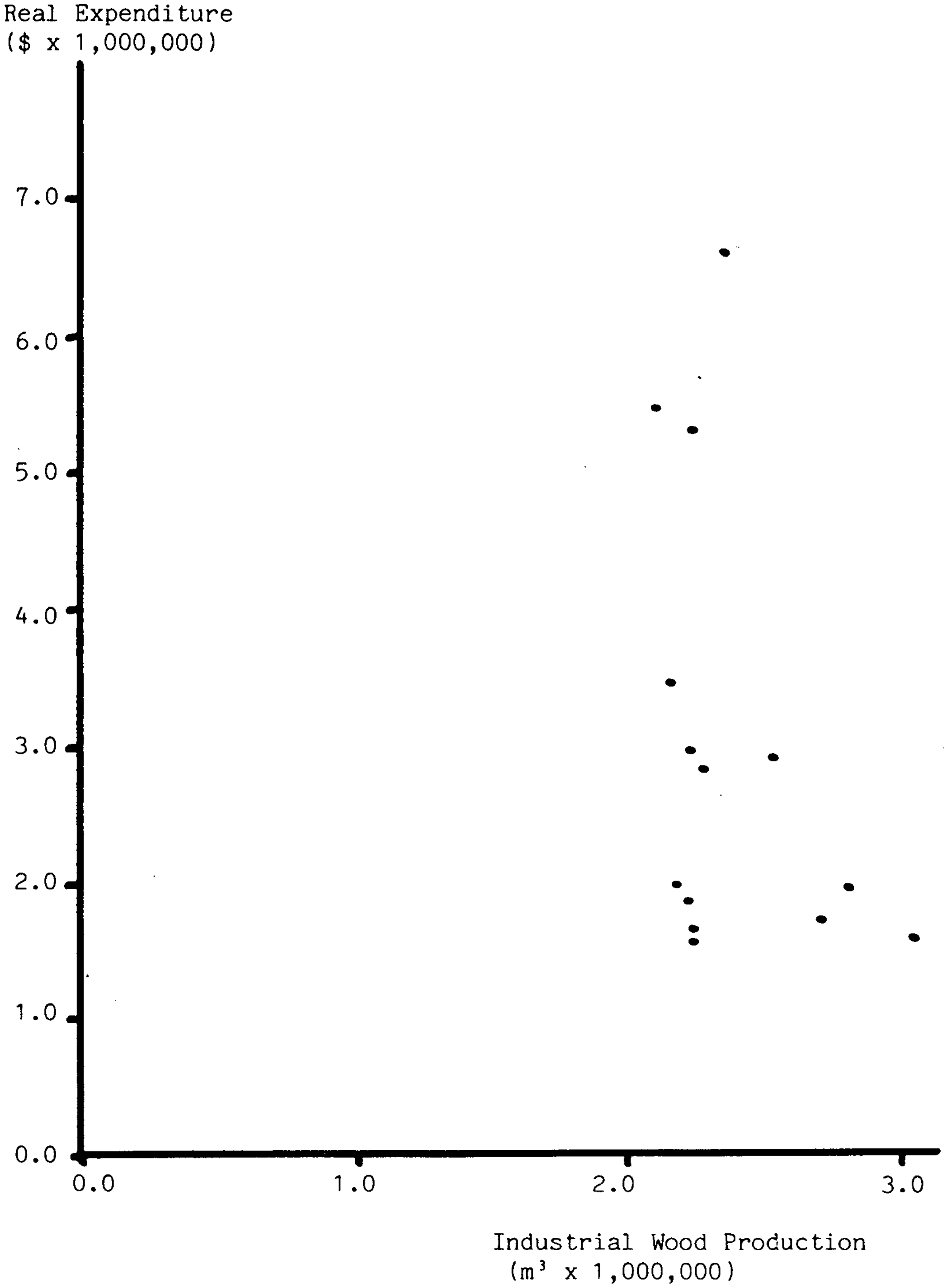
3. Calculation of real expenditures

Year	Nominal Expenditure[1] ($)	Implicit Price Index[2] 1971 = 100	Real Expenditure ($)
1968	1,627,101	82.2	1,979,442
1969	1,586,728	89.0	1,782,840
1970	1,586,839	94.2	1,684,542
1971	1,606,995	100.0	1,606,995
1972	1,612,774	107.2	1,504,453
1973	2,097,507	116.4	1,801,982
1974	3,424,685	135.1	2,534,926
1975	10,248,542	156.0	6,569,578
1976	9,376,031	177.4	5,285,249
1977	10,693,493	194.5	5,497,940
1978	6,166,479	210.7	2,926,663
1979	6,338,535	229.8	2,758,283
1980	7,459,136	260.0	2,868,898
1981	11,395,326	295.6	3,854,982

[1]Source: Section 2 of this appendix.

[2]Source: Statistics Canada, Catalogue 13-201 Annual. National Income and Expenditure Accounts. The index is the GNE Implicit Price Index, Government current expenditure on goods and services.

4. Real federal expenditure vs. industrial wood production



5. Statistical analysis of data

a) Real expenditure

1. $\bar{x}$ value ($)	3,046,912
2. Range ($)	1,504,453 to 6,569,578
3. Standard Deviation	1,642,401
4. Coefficient of Variation (%)	53.90
5. Average Annual Increase (%)	11.68

b) Nominal expenditure

1. Average Annual Increase (%)	23.44

c) Regression between industrial wood production and real government expenditure, where

x = wood production
y = real expenditure

Equation of regression; [$y = -1.3282(x) + 6,185,332$]

$r = -0.24$
$r^2 = 0.06$

Test of significance for r;

H_0: The correlation coefficient r in the population is not significantly different from zero.

H_1: The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero up to the 0.20 level of significance. Reject H_1, Accept H_o.

6. Federal government expenditure per m^3 and per ha.

Year	Expenditure Per m^3 ($)		Expenditure Per Ha. ($)	
	Nominal	Real	Nominal	Real
1968	0.75	0.92	78.27	95.22
1969	0.73	0.82	76.12	85.52
1970	0.59	0.62	61.08	64.84
1971	0.74	0.74	77.16	77.16
1972	0.73	0.67	75.45	70.38
1973	0.75	0.64	77.63	66.69
1974	1.12	0.83	116.17	85.99
1975	4.36	2.80	453.94	290.99
1976	4.19	2.36	435.71	245.61
1977	5.06	2.60	526.57	270.73
1978	2.83	1.34	294.46	139.75
1979	2.81	1.22	292.46	127.27
1980	2.95	1.14	307.11	118.12
1981	5.36	1.81	557.17	188.49

7. Moving average calculations, \$/m³, real data

	Time Period of Moving Average			
	3 year	5 year	7 year	9 year
	0.79	0.75	0.75	1.16
	0.73	0.70	1.02	1.34
	0.68	0.70	1.24	1.40
	0.68	1.14	1.52	1.47
	0.71	1.46	1.61	1.51
	1.42	1.85	1.68	1.64
	2.00	1.99	1.76	
	2.59	2.06	1.90	
	2.10	1.73		
	1.72	1.62		
	1.23			
	1.39			
$\bar{x}$ value (\$/m³)	1.34	1.40	1.44	1.42
Standard Deviation	0.65	0.54	0.40	0.16
Coefficient of Variation	48.51	38.57	27.78	11.27

APPENDIX 3

Provincial Public Revenues From Forestry

1. Summary of provincial forestry taxes

Year	Corporate Income Tax ($ 000)	Retail Sales Tax ($ 000)	Fuel Taxes ($ 000)	Forest Management Tax ($ 000)	Total ($ 000)
1967	137.8	1,658.7	111.3	-	1,907.8
1968	54.9	2,128.2	164.6	-	2,347.7
1969	63.1	2,492.8	173.9	-	2,729.8
1970	49.2	2,676.9	375.2	-	3,101.3
1971	50.9	3,083.1	202.3	-	3,336.3
1972	43.0	3,660.3	249.6	-	3,952.9
1973	96.5	4,285.3	439.1	-	4,820.9
1974	2,576.3	5,359.0	555.9	-	8,491.2
1975	1,941.3	7,089.4	292.5	615.8	9,323.2
1976	108.5	8,801.3	198.8	810.5	9,919.1
1977	1,453.7	10,145.4	164.9	759.0	12,523.0
1978	5,069.0	11,374.1	186.3	886.3	17,515.7
1979	6,922.9	12,822.1	248.0	923.5	20,916.5
1980	8,098.2	15,788.3	343.7	891.5	25,121.7
1981	7,892.9	17,852.1	256.9	917.5	26,909.4

2. Corporate income tax - Newfoundland

Year	Taxable Income ($ 000)[1]			Income Tax Paid ($ 000)[2]			Total Tax Paid ($ 000)
	Logging	Wood Ind.	Pulp-Paper	Logging	Wood Ind.	Pulp-Paper	
1967	*	100	1,000	16.8	11.0	110.0	137.8
1968	200	*	100	24.0	18.9	12.0	54.9
1969	*	*	100	27.6	22.5	13.0	63.1
1970	*	*	100	18.0	18.2	13.0	49.2
1971	200	100	*	26.0	13.0	11.9	50.9
1972	132	73	125	17.2	9.5	16.3	43.0
1973	189	149	404	24.6	19.4	52.5	96.5
1974	271	81**	19,466	35.2	10.5	2,530.6	2,576.3
1975	108	119**	14,706	14.0	15.5	1,911.8	1,941.3
1976	215	195**	365	30.1	27.3	51.1	108.5
1977	105	264**	10,010	15.3	37.0	1,401.4	1,453.7
1978	140	441	35,689	19.6	52.9	4,996.5	5,069.0
1979	305	554	48,669	42.7	66.5	6,813.7	6,922.9
1980	434	253	53,351	65.1	30.4	8,002.7	8,098.2
1981	481	265	51,926	72.2	31.8	7,788.9	7,892.9

[1]Source: (Statistics Canada, Cat. 61-208), (Anon., 1981c)

* Data confidential or unavailable

** Data confidential; estimated by applying percentage change in total taxable income for forestry in Canada, to taxable income in Newfoundland, beginning with 1977.

[2]Estimates from 1972 to 1981 calculated by applying provincial corporate income tax rates to taxable income. Estimates of taxes paid prior to 1972, derived by applying percentage change in provincial corporate income taxes paid in Canada for forestry, to Newfoundland tax paid in 1972, working backwards to 1967.

3. Total provincial corporate taxable income - Canada

Year	Logging	Sector Share ($ 000)[1] Wood Ind.	Pulp-Paper	Total
1972	29,690	162,635	151,505	343,830
1973	52,169	339,351	360,529	752,049
1974	42,160	182,922	744,411	969,493
1975	28,942	150,364	387,540	566,846
1976	43,436	245,446	375,114	663,996
1977	56,817	332,455	392,895	782,167
1978	65,406	554,759	644,059	1,264,224
1979	126,210	697,696	1,291,115	2,115,021
1980	147,949	318,650	1,378,262	1,884,861
1981	84,185	207,635	837,138	1,128,958

[1] Source: (Statistics Canada, Cat. 61-208)

4. Provincial corporate income tax rates - Newfoundland

Time Period	Tax Rate (%)
1967	11
1968	12
1969 - 1975	13
1976 - 1977	14
1978 - 1979	14 (12 % for small corporations)
1980 - 1981	15 (12 % for small corporations)

Source: (Anon., 1981c)

5. Total provincial and federal corporate income taxes paid, forestry sector (Canada as a whole).[1]

Year	Logging		Wood Industries		Pulp & Paper	
	Federal	Provincial	Federal	Provincial	Federal	Provincial
1967	3.5	1.4	19.3	6.1	72.9	20.6
1968	6.9	2.0	37.8	10.5	78.5	20.7
1969	7.0	2.3	46.4	12.5	92.1	23.4
1970	4.4	1.5	12.3	4.3	57.9	15.8
1971	4.4	1.7	22.6	7.2	43.0	12.7
1972	7.7	2.7	51.9	15.9	51.9	17.4
1973	14.4	5.0	94.1	35.0	107.0	39.8
1974	11.8	4.2	48.2	19.5	219.4	85.5
1975	7.0	2.9	38.6	16.2	108.8	44.3
1976	7.9	5.1	58.6	28.5	96.8	45.3
1977	10.5	6.6	79.5	38.5	97.1	45.8
1978	10.7	7.6	127.0	68.0	156.3	80.5
1979	24.4	14.9	161.6	86.8	298.7	160.6
1980	32.2	17.8	67.9	39.3	331.4	176.4
1981	13.2	9.0	45.5	25.4	201.9	110.9

[1] Source: (Statistics Canada, Cat. 61-208).

6. Percentage of personal expenditure on goods and services which is retail sales tax.*

Year	Tax Rate (%)	Total Consumption	Taxable Consumption	Sales Tax Paid	% Tax vs Total Consumption
1969	7	6,342	2,090	137	0.02
1972	7	8,361	3,020	198	0.02
1974	8	11,470	4,460	330	0.03
1976	10	13,152	5,020	456	0.03
1978	11	15,172	5,898	584	0.04

*Refers to expenditure by a family. Source: (Anon., 1981c)

7. Percentage of retail sales tax paid by individuals

Year	(1) Total Personal Consumption on Goods & Services ($000,000)[1]	(2) % of Tax Paid (%)[2]	(3) Total Tax Paid by Individuals ($000,000)[3]	(4) Total Retail Sales Tax Collected ($000,000)[4]	(5) % Sales Tax Paid [1-((3) (4)] (%)[5]
1969	724.1	0.02	14.5	35.6	59.3
1972	1,094.6	0.02	21.9	52.2	58.1
1974	1,543.5	0.03	46.3	76.5	39.5
1976	2,032.5	0.03	61.0	125.7	51.5
1978	2,476.7	0.04	99.1	162.4	39.0

[1] From Provincial Economic Accounts of Total GDP; Source (Anon., 1981c)

[2] Source (Section 6 of this appendix).

[3] Column (1) x Column (2)

[4] Source(Anon., 1981c) converted from fiscal to calendar years

[5] $\bar{x}$ value over the 5 years used is 49.50 %. This is similar to an estimate of 47 % used by Howard (1978), in a study of B.C. forest industry taxes.

8. Percentage of pulp and paper expenditure on non-wood materials and supplies vs. total manufacturing expenditure on materials and supplies.

Year	(1) Pulp & Paper Expenditures[1]	(2) Less Expenditures On Wood[2] ($ 000)	(3) Total Manufacturing Expenditures[3]	(4) Column 2 ÷ Column 3[4] (%)
1966	33,621	15,129	74,084	20.4
1967	32,040	14,418	76,358	18.9
1968	31,957	14,381	81,593	17.6
1969	32,507	14,628	98,474	14.9
1970	37,039	16,668	108,300	15.4
1971	29,402	13,231	114,816	11.5
1972	30,035	13,516	123,251	11.0
1973	60,394	27,177	153,626	17.7
1974	70,093	31,542	404,014	7.8
1975	59,498	26,774	386,023	6.9
1976	78,258	35,216	259,429	13.6

[1] Source: (Anon., 1981c)

[2] Estimated by deducting 55 % for costs of wood which are obtained locally and are not taxed. The 55 % figure derived from (Carroll and Milne, 1982).

[3] Excluding wood costs of pulp and paper industry. Source: (Anon., 1981c).

[4] Mean value is 14.15 % and represents the percentage of forest industry retail sales tax from total retail sales tax paid by all businesses in Newfoundland. The estimate is similar to the 15 % used by Howard (1978) in a study of B.C. forest industry taxes.

9. Calculation of retail sales tax paid by forest industry firms in Newfoundland.

Year	Total Retail Sales Tax Collected In Newfoundland ($ 000)[1]	Retail Sales Tax Paid By Forest Industry Firms In Newfoundland ($ 000)[2]
1967	23,681	1,658.7
1968	30,385	2,128.2
1969	35,590	2,492.8
1970	38,218	2,676.9
1971	44,017	3,083.1
1972	52,258	3,660.3
1973	61,181	4,285.3
1974	76,511	5,359.0
1975	101,216	7,089.4
1976	125,656	8,801.3
1977	144,847	10,145.4
1978	162,389	11,374.1
1979	183,062	12,822.1
1980	225,411	15,788.3
1981	254,875	17,852.1

[1] Source: (Anon., 1981c), converted from fiscal to calendar years.

[2] Estimated by multiplying column 1 by 0.07; product of (49.50) average retail sales tax paid by business and (14.15 %) average estimate of forest industry share of retail sales tax paid by business.

10. Fuel consumption, logging, Newfoundland[1]

Year	Fuel Consumption (000 Litres) Gasoline	Diesel
1967	3,436	5,928
1968	4,076	7,298
1969	4,136	7,426
1970	9,476	18,859
1971	4,116	7,384
1972	4,686	8,604
1973	10,556	21,170
1974	13,116	26,652
1975	6,168	11,832
1976	4,777	8,345
1977	4,027	7,027
1978	3,750	7,009
1979	4,996	9,268
1980	7,716	15,091
1981	3,726	6,549

[1] Source: 1975 to 1978, (Statistics Canada, Cat. 57-208) Data for all other years confidential or unavailable. Data for missing years estimated using simple regression between published fuel consumption data and industrial wood consumption, Newfoundland for 1975 to 1978. Equations are:

Gasoline consumption = 2.20 (wood production) - 3,859.75; then converted to litres. $r = 0.93$, $r^2 = 0.86$.

Diesel consumption = 4.71 (wood production) - 8,577.49; then converted to litres. $r = 0.94$, $r^2 = 0.89$.

Both r values significantly different from zero at 0.05 level using t-test. For logging, fuel oil consumption is negligible over the study period.

11. Fuel consumption, wood industries, Newfoundland[1]

	Fuel Consumption (000 litres)		
Year	Gasoline	Diesel[2]	Fuel Oil
1967	141	191	1,207
1968	145	255	1,589
1969	218	295	1,849
1970	314	432	2,697
1971	386	536	3,360
1972	445	1,009	6,337
1973	486	645	5,206
1974	555	877	6,356
1975	400	686	5,555
1976	218	182	3,186
1977	118	68	1,932
1978	150	114	1,932
1979	200	418	2,859
1980	177	250	2,445
1981	55	82	2,409

[1] Source: 1975 to 1981 (Statistics Canada, Cat. 57-208). 1967 to 1974: Data estimated using published statistics of fuel consumption in the wood industries for Atlantic Region, including Newfoundland (Statistics Canada, Cat. 57-506). Estimates and limited published data for Newfoundland sector in 1974 (Milne, 1981) were compared with data for Atlantic Region in 1974 to compute Newfoundland share of Atlantic Region fuel consumption. These ratios were applied to published Atlantic Region data in 1967 to 1974.

[2] Diesel Consumption prior to 1973 was included in fuel oil data. Estimates of diesel consumption from 1967 to 1972 were made by applying the average ratio of diesel to diesel plus fuel oil for 1973 to 1981.

12. Fuel Consumption, pulp and paper, Newfoundland[1]

Year	Fuel Consumption (000 litres) Gasoline	Diesel	Fuel Oil
1967	180	191	112,218
1968	162	198	116,010
1969	151	228	133,949
1970	127	286	167,655
1971	188	311	182,642
1972	119	346	202,957
1973	159	345	225,707
1974	232	469	252,793
1975	245	413	177,031
1976	282	368	190,873
1977	223	430	204,270
1978	291	705	152,873
1979	239	460	218,431
1980	259	498	236,513
1981	270	520	246,972

[1]Source: 1975, 1976, 1978 (Statistics Canada, Cat. 57-208), data for all other years confidential or unavailable. Missing data for 1967 to 1974 estimated by using fuel consumption data (Statistics Canada, Cat. 57-506) for paper and allied industries in Atlantic Region. Data for Newfoundland derived by applying ratio of wood pulp production in Newfoundland vs. Atlantic Region to Atlantic Region fuel consumption data. Newfoundland fuel consumption for 1977, 1979 to 1981 estimated by applying average fuel consumption per tonne newsprint from 1970 to 1978 (excluding 1977), to newsprint production in the missing years. No significant difference in mean fuel consumption/tonne newsprint between estimated data 1970 to 1974, and published Newfoundland data 1975, 1976, 1978. Levels of significance were: Gasoline, 0.001; Diesel, 0.02; Fuel Oil, 0.02 using Student-t Test.

13. Fuel tax exemptions[1]

1) Logging
   a) Gasoline - tax exempt except for transport and road construction
   b) Diesel - tax exempt until 1980; similar exceptions
   c) Fuel Oil - fully taxed

2) Processing
   a) Gasoline - fully taxed
   b) Diesel - fully taxed
   c) Fuel Oil - tax exempt

14. Provincial tax rates on fuel[2]

Time Period Of Tax	Tax (cents/litre) Gasoline	Diesel	Fuel Oil
1967	4.4	4.4	0.22
1968-1978	5.5	5.5	0.22
1979-1980	6.0	6.0	0.22
1981	7.1	8.2	0.22

[1] Source: (Milne, 1981b); (Anon., 1985a) Revenue Branch, Department ofFinance, Government of Newfoundland and Labrador.

[2] Source: (Anon., 1981c)

15. Estimates of provincial fuel taxes

Year	Industry Sector	Fuel Tax ($) Gasoline	Diesel	Total
1967	Logging	15,118	65,208	80,326
	Wood Industry	6,204	8,404	14,608
	Pulp & Paper	7,920	8,404	16,324
	TOTAL........	29,242	82,016	111,258
1968	Logging	22,418	100,348	122,766
	Wood Industry	7,975	14,025	22,000
	Pulp & Paper	8,910	10,890	19,800
	TOTAL........	39,303	125,263	164,566
1969	Logging	22,748	102,108	124,856
	Wood Industry	11,990	16,225	28,215
	Pulp & Paper	8,305	12,540	20,845
	TOTAL........	43,043	130,873	173,916
1970	Logging	52,118	259,311	311,429
	Wood Industry	17,270	23,760	41,030
	Pulp & Paper	6,985	15,730	22,715
	TOTAL........	76,373	298,801	375,174
1971	Logging	22,638	101,530	124,168
	Wood Industry	21,230	29,480	50,710
	Pulp & Paper	10,340	17,105	27,445
	TOTAL........	54,208	148,115	202,323
1972	Logging	25,773	118,305	144,078
	Wood Industry	24,475	55,495	79,970
	Pulp & Paper	6,545	19,030	25,575
	TOTAL........	56,793	192,830	249,623
1973	Logging	58,058	291,088	349,146
	Wood Industry	26,730	35,475	62,205
	Pulp & Paper	8,745	18,975	27,720
	TOTAL........	93,533	345,538	439,071
1974	Logging	72,138	366,465	438,603
	Wood Industry	30,525	48,235	78,760
	Pulp & Paper	12,760	25,795	38,555
	TOTAL........	115,423	440,495	555,918
1975	Logging	33,924	162,690	196,614
	Wood Industry	22,000	37,730	59,730
	Pulp & Paper	13,475	22,715	36,190
	TOTAL........	69,399	223,135	292,534

Continued/...

15. Estimates of provincial fuel taxes (Continued)

Year	Industry Sector	Fuel Tax ($) Gasoline	Diesel	Total
1976	Logging	26,274	114,744	141,018
	Wood Industry	11,990	10,010	22,000
	Pulp & Paper	15,510	20,240	35,750
	TOTAL........	53,774	144,994	198,768
1977	Logging	22,149	96,621	118,770
	Wood Industry	6,490	3,740	10,230
	Pulp & Paper	12,265	23,650	35,915
	TOTAL........	40,904	124,011	164,915
1978	Logging	20,625	96,374	116,999
	Wood Industry	8,250	6,270	14,520
	Pulp & Paper	16,005	38,775	54,780
	TOTAL........	44,880	141,419	186,299
1979	Logging	29,976	139,020	168,996
	Wood Industry	12,000	25,080	37,080
	Pulp & Paper	14,340	27,600	41,940
	TOTAL........	56,316	191,700	248,016
1980	Logging	46,296	226,365	272,661
	Wood Industry	10,620	15,000	25,620
	Pulp & Paper	15,540	29,880	45,420
	TOTAL........	72,456	271,245	343,701
1981	Logging	26,455	134,255	160,710
	Wood Industry	3,905	20,500	24,405
	Pulp & Paper	19,170	42,640	61,810
	TOTAL........	49,530	197,395	246,925

16. Forest management tax[1]

Year	Tax Collected[2]
1975	615,750
1976	810,500
1977	759,000
1978	886,250
1979	923,500
1980	891,500
1981	917,500

[1]Source: (Anon., 1984d) Department of Forest Resources and Lands

[2]Data transformed from fiscal to calendar basis.

17. Summary of provincial non-tax forestry revenues[1]

Year	Sawmill Licences	Timber Rentals	Timber Stumpage	Cutting Permits	Total Non-Tax Revenue
	($ 000)				
1967	21.4	31.1	141.2	4.4	198.1
1968	22.1	31.1	162.7	4.2	220.1
1969	22.8	31.1	127.8	4.5	186.2
1970	20.4	31.1	160.1	4.4	216.0
1971	19.8	31.1	212.1	4.2	267.2
1972	22.3	26.5	220.9	4.0	273.7
1973	25.5	21.9	149.0	4.4	200.8
1974	27.8	49.5	385.1	4.8	467.2
1975	29.6	44.9	745.2	7.6	827.3
1976	23.2	31.1	854.4	15.2	923.9
1977	19.3	29.3	881.3	20.0	949.9
1978	30.0	26.3	283.3	23.5	363.1
1979	33.3	32.8	257.3	28.8	352.2
1980	35.5	34.0	304.5	40.0	414.0
1981	39.0	36.8	417.5	40.0	533.3

[1]Source: (Anon., 1981c) and (Anon., 1984d).
Data transformed from fiscal to calendar year.

18. Calculation of net income - provincial government, Newfoundland

Year	Total Tax Revenues[1]	Total Non-Tax Revenues[2]	Gross Income	Total Provincial Forestry Expenditures[3]	Net Income
	($ 000)				
1967	1,907.8	198.1	2,105.9	2,932.2	-826.3
1968	2,347.7	220.1	2,567.8	3,130.2	-562.4
1969	2,729.8	186.2	2,916.0	2,994.8	- 78.8
1970	3,101.3	216.0	3,317.3	1,684.4	1,632.9
1971	3,336.3	267.2	3,603.5	2,889.7	713.8
1972	3,952.9	273.7	4,226.6	3,683.9	542.7
1973	4,820.9	200.8	5,021.7	4,108.1	913.6
1974	8,491.2	467.2	8,958.4	4,427.2	4,531.2
1975	9,323.2	827.3	10,150.5	5,651.3	4,499.2
1976	9,919.1	923.9	10,843.0	6,046.1	4,796.9
1977	12,523.0	949.9	13,472.9	6,572.0	6,900.9
1978	17,515.7	363.1	17,878.8	7,277.1	10,601.7
1979	20,916.5	352.2	21,268.7	9,879.6	11,389.1
1980	25,121.7	414.0	25,535.7	9,955.4	15,580.3
1981	26,909.4	533.3	27,442.7	12,116.6	15,326.1

[1]Source: Appendix 3

[2]Source: Appendix 3

[3]Source: Appendix 1

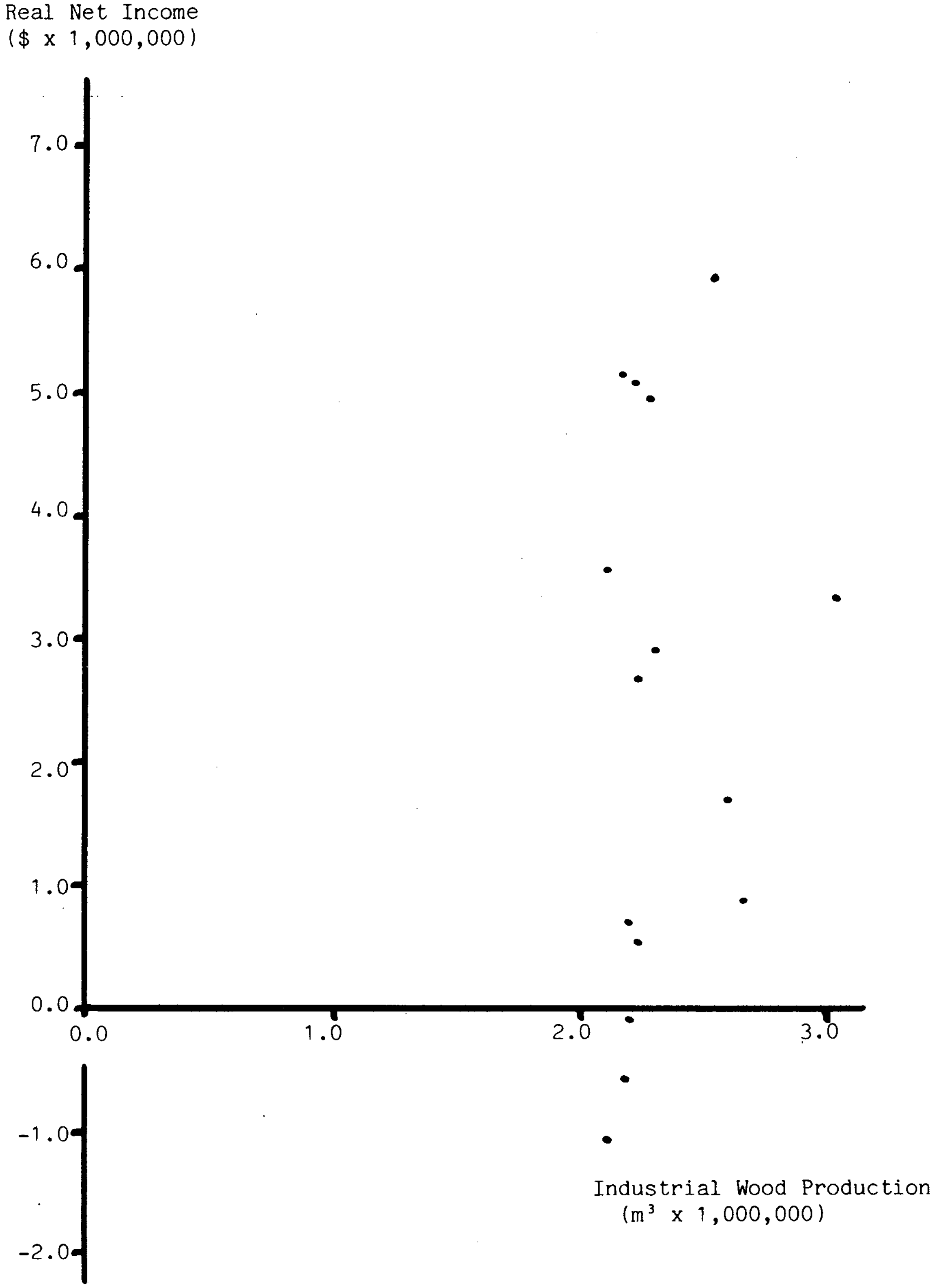
19. Calculation of real net income

Year	Nominal Net Income[1] ($ 000)	Implicit Price Index[2] 1971 = 100	Real Net Income ($ 000)
1967	-826.3	77.8	-1,062.1
1968	-562.4	82.2	-684.2
1969	-78.8	89.0	-88.5
1970	1,632.9	94.2	1,733.4
1971	713.8	100.0	713.8
1972	542.7	107.2	506.3
1973	913.6	116.4	784.9
1974	4,531.2	135.1	3,354.0
1975	4,499.2	156.0	2,884.1
1976	4,796.9	177.4	2,704.0
1977	6,900.9	194.5	3,548.0
1978	10,601.7	210.7	5,031.7
1979	11,389.1	229.8	4,956.1
1980	15,580.3	260.0	5,992.4
1981	15,326.1	195.6	5,184.7

[1] Source: Appendix 3

[2] Source: (Statistics Canada, Cat. 13-201). This is the same Implicit Price Index used to deflate government expenditures.

20. Real net provincial forestry income vs. industrial wood production



21. Statistical analysis of data

a) Real net income

1. $\bar{x}$ value (\$)	2,370,573
2. Range (\$)	-1,062,100 to 5,992,400
3. Standard Deviation	295,014
4. Coefficient of Variation (%)	12.44
5. Average Annual Increase (%)	2.03

b) Nominal expenditure

1. Average Annual Increase (%)	2.20

c) Regression between industrial wood production and real net income, where

x = wood production
y = real net income

Equation of regression [$y = 0.9555(x) + 129{,}634$]

$r = 0.12$
$r^2 = 0.02$

Test of significance for r :

H_0 : The correlation coefficient r in the population is not significantly different from zero.
H_1 : The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero up to 0.20 level of significance. Reject H_1, Accept H_0.

22. Real net provincial income per m^3 and per ha.

Year	Net Income Per m^3 ($)		Net Income Per Ha. ($)	
	Nominal	Real	Nominal	Real
1967	-0.39	-0.51	-40.96	-52.65
1968	-0.26	-0.32	-27.05	-32.91
1969	-0.04	-0.04	- 3.78	- 4.25
1970	0.60	0.64	62.85	66.72
1971	0.33	0.33	34.27	34.27
1972	0.24	0.23	25.39	23.69
1973	0.33	0.28	33.81	29.05
1974	1.48	1.09	153.70	113.77
1975	1.92	1.23	199.28	127.75
1976	2.14	1.21	222.91	125.66
1977	3.27	1.68	339.81	174.71
1978	4.87	2.31	506.24	240.27
1979	5.05	2.20	525.50	228.68
1980	6.17	2.37	641.48	246.72
1981	7.21	2.44	749.37	253.51

APPENDIX 4

Federal Public Revenues From Forestry

1. Summary of federal forestry taxes

Year	Corporate Income Tax ($ 000)	Excise Taxes ($ 000)	TOTAL ($ 000)
1967	72.8	925.0	997.8
1968	89.6	763.0	852.6
1969	104.7	891.2	995.9
1970	72.8	1,114.1	1,186.9
1971	65.1	1,038.2	1,103.3
1972	100.3	1,001.5	1,101.8
1973	213.4	1,330.1	1,543.5
1974	5,834.3	1,737.4	7,571.7
1975	4,185.2	1,116.6	5,301.8
1976	179.9	1,369.7	1,549.6
1977	2,557.1	1,199.4	3,756.5
1978	8,784.9	1,353.7	10,138.6
1979	11,517.5	1,477.5	12,995.0
1980	12,976.5	1,880.1	14,856.6
1981	12,657.0	2,370.8	15,027.8

2. Corporate income tax - Newfoundland

Year	Taxable Income ($ 000)[1] Logging	Wood Ind.	Pulp & Paper	Income Tax Paid ($ 000)[2] Logging	Wood Ind.	Pulp & Paper	Total Tax Paid ($ 000)
1967	*	100	1,000	4.0	8.6	60.2	72.8
1968	200	*	100	7.9	16.9	64.8	89.6
1969	*	*	100	8.0	20.7	76.0	104.7
1970	*	*	100	19.5	5.5	47.8	72.8
1971	200	100	*	19.5	10.1	35.5	65.1
1972	132	73	125	34.2	23.3	42.8	100.3
1973	189	149	404	52.2	41.3	119.9	213.4
1974	271	81**	19,466	75.8	21.3	5,737.2	5,834.3
1975	108	119**	14,706	26.1	30.5	4,128.6	4,185.2
1976	215	195**	365	39.1	46.6	94.2	179.9
1977	109	264**	10,010	20.1	63.1	2,473.9	2,557.1
1978	140	441	35,689	22.9	101.0	8,661.0	8,784.9
1979	305	554	48,669	59.0	128.3	11,330.2	11,517.5
1980	434	253	53,351	94.5	53.9	12,828.1	12,976.5
1981	481	265	51,926	75.4	58.1	12,523.5	12,657.0

[1]Source: (Statistics Canada, Cat. 61-208), (Anon., 1981c)
* Data not available
** Data estimated by applying percentage change in total taxable income for forestry in Canada, to taxable income in Newfoundland, beginning with 1977

[2]Estimates from 1972 calculated by applying ratio of Newfoundland taxable income in forestry vs. Canadian total, to total forestry corporate income taxes paid (federal) in Canada.
Estimates from 1967 to 1971 calculated by applying percentage change in federal corporate income taxes paid in Canada for forestry, to Newfoundland tax paid in 1972, working backwards to 1967.

3. Federal excise tax on materials and supplies.

Year	Expenditure On Material - Supplies ($ 000)[1]				Federal Excise Tax[2] ($ 000)
	Logging	Wood Ind.	Pulp & Paper	TOTAL	
1967	5,082	3,067	32,040	40,198	301.5
1968	4,829	2,475	31,957	39,261	294.5
1969	5,982	3,018	32,507	41,507	311.3
1970	7,780	3,198	37,039	48,017	360.1
1971	4,738	3,151	29,402	37,291	279.7
1972	5,614	4,179	30,035	39,828	298.7
1973	11,784	4,216	60,394	76,394	573.0
1974	19,328	5,562	70,093	94,983	712.4
1975	17,140	5,980	59,498	82,618	619.6
1976	17,504	7,854	78,258	103,616	777.1
1977	12,512	9,455	53,176	75,143	563.6
1978	14,770	10,685	70,220	95,675	717.6
1979	20,127	12,048	90,070	122,245	706.6
1980	26,218	12,103	100,248	138,569	800.9
1981	37,669	14,398	106,619	158,686	917.2

[1] Source: (Statistics Canada, Cat. 25-202)

[2] Estimated by assuming 7 percent of expenditures are taxed. Tax rate on manufacturer's selling value 12 percent 1967 to 1978, 9 percent 1979 to 1981. (Anon., 1985b).

4. Federal excise tax on building and construction items.

Year	Capital and Repair Expenditure ($000)[1] Wood Industry	Pulp and Paper	Total	Federal Tax[2] ($ 000)
1967	334.1	11,930.1	12,264.2	607.7
1968	355.4	8,739.6	9,095.0	450.7
1969	582.1	10,770.8	11,352.9	562.5
1970	583.2	13,802.9	14,386.1	712.8
1971	634.4	14,223.3	14,857.7	736.2
1972	748.0	12,892.9	13,640.9	675.9
1973	1,083.7	12,972.9	14,056.6	696.5
1974	1,154.7	17,615.8	18,770.5	930.1
1975	1,063.1	17,375.5	18,438.6	439.0
1976	1,157.3	21,599.8	22,757.1	541.8
1977	1,211.6	23,467.1	24,678.7	587.6
1978	1,536.3	22,941.1	24,477.4	582.8
1979	1,860.3	28,226.4	30,086.7	716.4
1980	2,069.9	39,170.4	41,240.3	981.9
1981	1,935.7	56,157.9	58,093.6	1,383.2

[1] Capital and repair data not available for Newfoundland. Data estimated for wood industries and pulp and paper by applying the ratio of Newfoundland expenditures on materials and supplies (Statistics Canada, Cat. 25-202) for both sectors vs. total national expenditures, to the total national expenditure on capital and repair. Logging sector excluded since building and construction expenditures are negligible.

[2] Tax calculated on 50 percent of capital and repair expenditures at 11 percent tax rate 1967 to 1974, and 5 percent tax rate thereafter.

5. Federal excise tax on fuels.

Year	Tax Paid by Sector ($ 000)[1]			
	Logging[2]	Wood Industry[3]	Pulp & Paper[4]	Total
1967	14.1	0.7	1.0	15.8
1968	16.3	0.7	0.8	17.8
1969	15.7	0.9	0.8	17.4
1970	38.9	1.5	0.8	41.2
1971	18.9	2.1	1.3	22.3
1972	23.0	2.8	1.1	26.9
1973	55.9	3.1	1.6	60.6
1974	85.3	6.2	3.4	94.9
1975	49.3	4.6	4.1	58.0
1976	43.5	2.4	4.9	50.8
1977	41.1	1.4	5.7	48.2
1978	41.3	2.1	9.9	53.3
1979	45.0	3.2	6.3	54.5
1980	84.9	3.2	9.2	97.3
1981	55.9	1.4	13.1	70.4

[1] Includes taxes assessed on gasoline and diesel fuels

[2] Diesel exempt from tax

[3] Diesel exempt for sawmilling. Adjustments were made to total fuel consumption in wood industries sector from published data (Statistics Canada, Cat. 57-208). Diesel consumption in sawmilling averaged 38 percent of total diesel consumption in wood industries.

[4] No exemptions in pulp and paper

6. Federal tax rates on gas and diesel fuel

Year	Federal Tax (¢/litre)[1]	
	Gas	Diesel
1967	0.41	0.13
1968	0.40	0.08
1969	0.38	0.09
1970	0.41	0.11
1971	0.46	0.14
1972	0.49	0.16
1973	0.53	0.23
1974	0.65	0.40
1975	0.80	0.53
1976	0.91	0.64
1977	1.02	0.79
1978	1.10	0.95
1979	0.90	0.90
1980	1.10	1.27
1981	1.50	1.74

[1]Estimated values. The tax is based on a percentage of manufacturer's selling price (12 percent 1967 to 1978; 9 percent thereafter). Manufacturer's selling price estimated as 50 percent of retail selling price (Canadian Petroleum Association, 1985) less Provincial fuel taxes (Anon. 1981c). The Federal taxes on a per litre basis can be applied to fuel consumption data to derive taxes paid.

7. Calculation of net income, federal government

Year	Total Tax Revenues[1]	Total Forestry Expenditures[2]	Net Income
	................($ 000)................		
1967	997.8	*	*
1968	852.6	1,627.1	- 774.5
1969	995.9	1,586.7	- 590.8
1970	1,186.9	1,586.8	- 399.9
1971	1,103.3	1,607.0	- 503.7
1972	1,101.8	1,612.8	- 511.0
1973	1,543.5	2,097.5	- 554.0
1974	7,571.7	3,424.7	4,147.0
1975	5,301.8	10,248.5	-4,946.7
1976	1,549.6	9,376.0	-8,698.9
1977	3,756.5	10,693.5	-6,937.0
1978	10,138.6	6,166.5	3,972.1
1979	12,995.0	6,338.5	6,656.5
1980	14,856.6	7,459.1	7,397.5
1981	15,027.8	11,395.3	3,632.5

[1]Source: Appendix 4

[2]Source: Appendix 2

*Note: expenditures could not be estimated for 1967

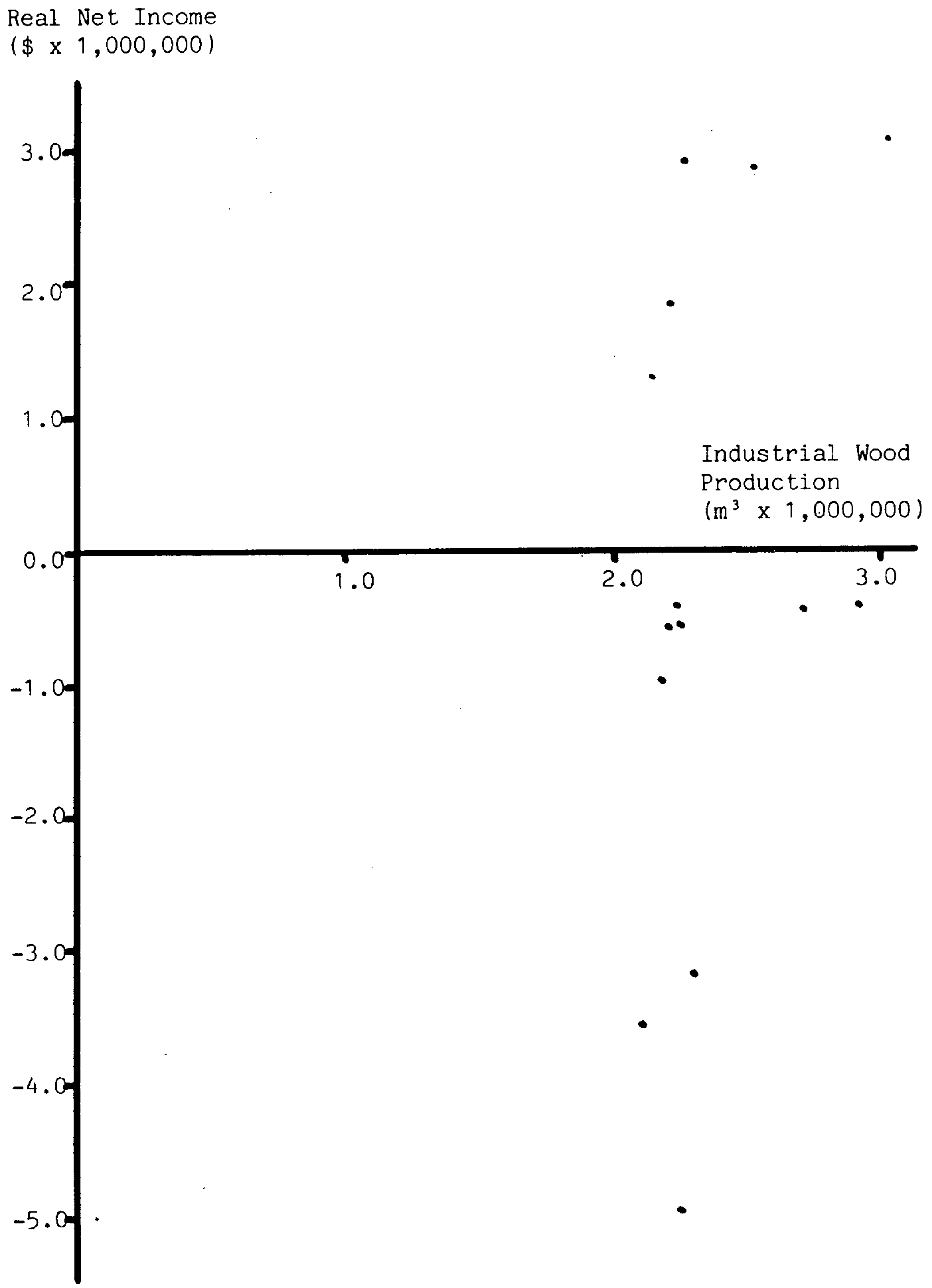
8. Calculation of real net income

Year	Nominal Net Income ($000)[1]	Implicit Price Index 1971 = 100[2]	Real Net Income ($000)
1968	- 774.5	82.2	- 942.2
1969	- 590.8	89.0	- 663.8
1970	- 399.9	94.2	- 424.5
1971	- 503.7	100.0	- 503.7
1972	- 511.0	107.2	- 476.7
1973	- 554.0	116.4	- 475.9
1974	4,147.0	135.1	3,069.6
1975	-4,946.7	156.0	-3,171.0
1976	-8,698.9	177.4	-4,903.6
1977	-6,937.0	194.5	-3,566.6
1978	3,972.1	210.7	1,885.2
1979	6,656.6	229.8	2,896.6
1980	7,397.5	260.0	2,845.2
1981	3,632.5	295.6	1,228.9

[1]Source: Appendix 4

[2]Source: (Statistics Canada, Cat. 13-201). This is the same Implicit Price Index used to deflate government expenditures.

9. Real net federal forestry income vs. industrial wood production.



10. Statistical analysis of data

a) Real net income

1.	$\bar{x}$ value ($)	-228,821
2.	Range ($)	-4,903,600 to 3,069,600
3.	Standard Deviation	2,469,455
4.	Coefficient of Variation (%)	1,079.21
5.	Average Annual Increase (%)	0.49

b) Nominal expenditure

1.	Average Annual Increase (%)	0.59

c) Regression between industrial wood production and real net income, where :

x = wood production
y = real net income

Equation of regression: [$y = 2.9057(x) - 7,094,611$]

$r = 0.35$
$r^2 = 0.12$

Test of significance for r;

H_0: The correlation coefficient r in the population is not significantly different from zero.

H_1: The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero up to 0.20 level of significance. Reject H_1; Accept H_0.

11. Real net federal income per m^3 and per ha.

Year	Net Income Per m^3 (\$)		Net Income Per Ha. (\$)	
	Nominal	Real	Nominal	Real
1968	- 0.36	- 0.44	- 37.26	- 45.32
1969	- 0.27	- 0.31	- 28.34	- 31.84
1970	- 0.15	- 0.16	- 15.39	- 16.34
1971	- 0.23	- 0.23	- 24.18	- 24.18
1972	- 0.23	- 0.21	- 23.91	- 22.30
1973	- 0.20	- 0.17	- 20.50	- 17.61
1974	1.35	1.00	140.67	104.12
1975	- 2.11	- 1.35	-219.10	-140.45
1976	- 3.89	- 2.19	-404.24	-227.87
1977	- 3.28	- 1.69	-341.59	-175.63
1978	1.82	0.87	189.67	90.02
1979	2.95	1.29	307.13	133.65
1980	2.93	1.13	304.57	117.14
1981	1.71	0.58	177.61	60.09

APPENDIX 5

Net Social Value - Provincial Accounting Stance

1. Calculation of real value added

Year	Nominal Value Added[1] ($000)	Implicit Price Index[2] (1971 = 100)	Real Value Added ($000)
1967	58,351	85.9	67,929.0
1968	51,728	88.7	58,318.0
1969	55,097	92.6	59,500.0
1970	60,950	96.9	62,900.0
1971	53,446	100.0	53,446.0
1972	59,949	105.0	57,094.3
1973	87,785	114.6	76,601.2
1974	146,603	132.1	110,979.0
1975	115,651	146.3	79,050.6
1976	111,198	160.4	69,325.4
1977	146,047	172.3	84,763.2
1978	185,019	183.8	100,663.2
1979	207,373	202.7	102,305.4
1980	215,100	225.8	95,261.3
1981	254,596	249.7	101,960.8

[1]Source: (Statistics Canada, Cat. 25-202)

[2]Source: (Statistics Canada, Cat. 13-201), Index is the Implicit Price Index, Gross National Expenditure.

2. Calculation of net social value, nominal data

Year	Nominal Value Added[1]	Provincial Government Expenditures[2]	Net Social Value
	....	($ 000)	....
1967	58,351	2,932.2	55,418.8
1968	51,728	3,130.2	48,597.8
1969	55,097	2,994.8	52,102.2
1970	60,950	1,684.4	59,265.6
1971	53,446	2,889.7	50,556.3
1972	59,949	3,683.9	56,265.1
1973	87,785	4,108.1	83,676.9
1974	146,603	4,427.2	142,175.8
1975	115,651	5,651.3	109,999.7
1976	111,198	6,046.1	105,151.9
1977	146,047	6,572.0	139,475.0
1978	185,019	7,277.1	177,741.9
1979	207,373	9,879.6	197,493.4
1980	215,100	9,955.4	205,144.6
1981	254,596	12,116.6	242,479.4

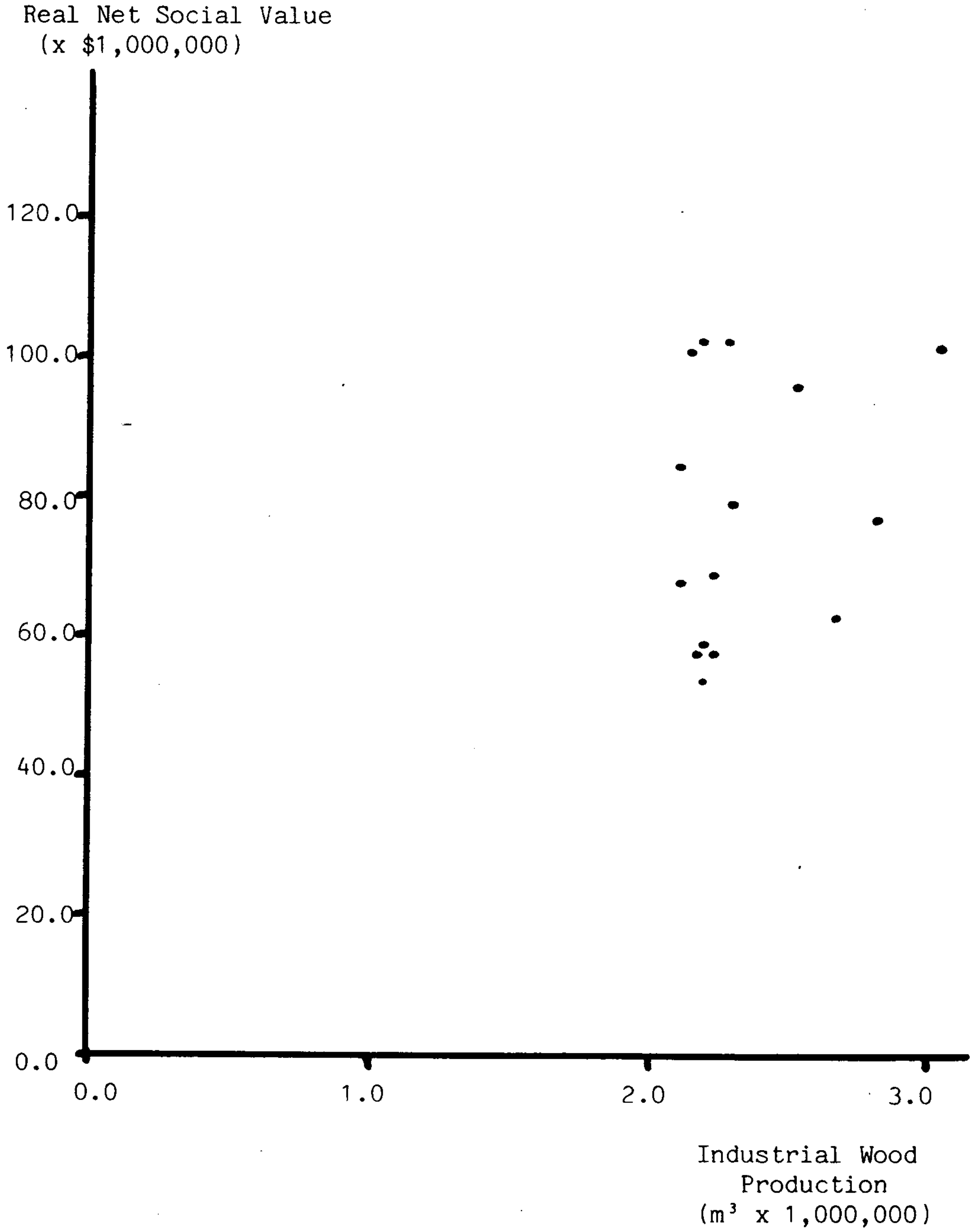
[1]Source: Appendix 5, Section 1

[2]Source: Appendix 1, Section 3

3. Calculation of net social value, real data

Year	Real Value Added	Real Provincial Government Expenditure	Real Net Social Value
	......................($ 000)	....	
1967	67,929.0	3,768.9	64,160.1
1968	58,318.0	3,808.0	54,510.0
1969	59,500.0	3,365.0	56,135.0
1970	62,900.0	1,788.2	61,111.8
1971	53,446.0	2,889.7	50,556.3
1972	57,094.3	3,436.5	53,657.8
1973	76,601.2	3,529.3	73,071.9
1974	110,979.0	3,277.0	107,702.0
1975	79,050.6	3,622.7	75,427.9
1976	69,325.4	3,408.2	65,917.2
1977	84,763.2	3,379.0	81,384.2
1978	100,663.2	3,453.8	97,209.4
1979	102,305.4	4,299.2	98,006.2
1980	95,261.3	3,829.0	91,432.3
1981	101,960.8	4,099.0	97,861.8

4. Net social value vs. industrial wood production.



5. Statistical analysis of data

a) Real net social value

1.	$\bar{x}$ value ($)	75,209,593
2.	Range ($)	50,556,300 to 107,702,000
3.	Standard Deviation	19,180,050
4.	Coefficient of Variation (%)	25.50
5.	Average Annual Increase (%)	4.71

b) Nominal net social value

1.	Average Annual Increase (%)	12.67

c) Regression between industrial wood production and real net social value, where

x = production
y = net social value

Equation of regression: [$y = 21.4546(x) + 24{,}893{,}318$]

$r = 0.33$
$r^2 = 0.11$

Test of significance for r:

H_o = The correlation coefficient r in the population is not significantly different from zero.

H_1 = The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero to 0.20 level of significance. Reject H_1, Accept H_o.

6. Net social value per m^3 and per ha.

Year	Value Per m^3 ($) Nominal	Real	Value per Ha. ($) Nominal	Real
1967	26.42	32.38	2,747.18	3,367.32
1968	22.48	26.97	2,337.78	2,805.37
1969	24.03	27.44	2,499.39	2,854.26
1970	21.93	23.28	2,281.11	2,421.00
1971	23.34	23.34	2,427.44	2,427.44
1972	25.31	24.13	2,632.29	2,510.31
1973	29.78	27.26	3,096.97	2,835.09
1974	46.37	36.20	4,822.62	3,764.42
1975	46.85	33.67	4,872.20	3,501.38
1976	46.98	30.98	4,886.46	3,221.59
1977	66.04	40.13	6,867.98	4,173.88
1978	81.61	46.22	8,487.34	4,806.76
1979	87.62	45.39	9,112.42	4,720.41
1980	81.21	37.71	8,446.34	3,922.15
1981	114.00	47.94	11,856.02	4,985.37

APPENDIX 6

Net Social Value - National Accounting Stance

1. Calculation of net social value, nominal data

Year	Nominal Value Added[1]	Provincial Plus Federal Government Expenditures[2]	Net Social Value
	....................($ 000)...	...	...
1967	58,531	-	-
1968	51,728	4,757.3	46,970.7
1969	55,097	4,581.6	50,515.4
1970	60,950	3,271.3	57,678.7
1971	53,446	4,496.7	48,949.3
1972	59,949	5,296.7	54,652.3
1973	87,785	6,205.6	81,579.4
1974	146,603	7,851.9	138,751.1
1975	115,651	15,899.9	99,751.1
1976	111,198	15,421.1	95,776.9
1977	146,047	17,265.5	128,781.5
1978	185,019	13,443.6	171,575.4
1979	207,373	16,218.2	191,154.8
1980	215,100	17,414.5	197,685.5
1981	254,596	23,511.9	231,084.1

[1]Source: Appendix 5, Section 1

[2]Source: Appendix 1, Section 3
Appendix 2, Section 3

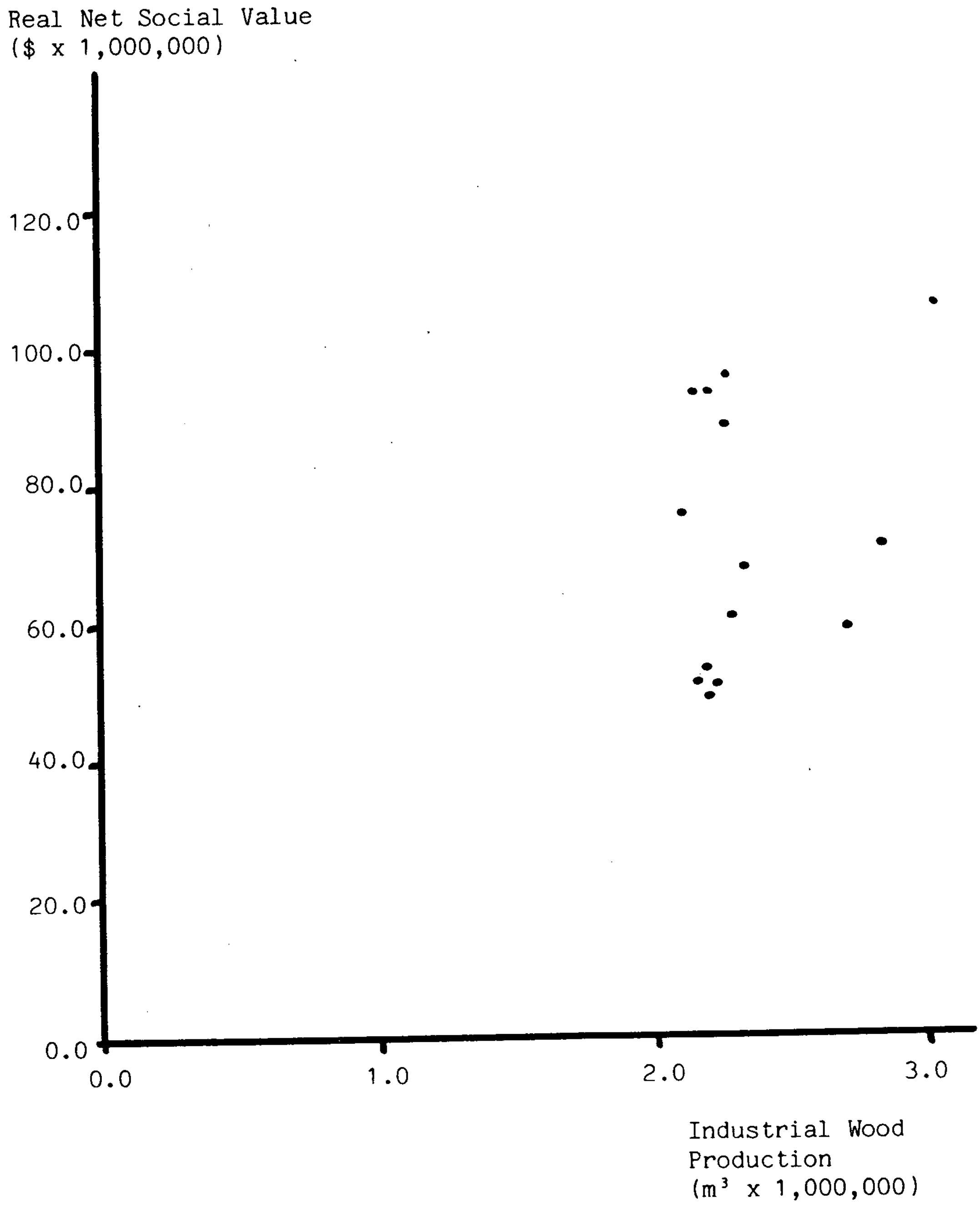
2. Calculation of net social value, real data

Year	Real Value Added[1]	Real Provincial Plus Federal Government Expenditures[2]	Real Net Social Value
	....	($ 000)	....
1967	67,929.0	-	-
1968	58,318.0	5,787.4	52,530.6
1969	59,500.0	5,147.8	54,352.2
1970	62,900.0	3,472.7	59,427.3
1971	53,446.0	4,496.7	48,949.3
1972	57,094.3	4,940.9	52,153.4
1973	76,601.2	5,331.3	71,269.9
1974	110,979.0	5,811.9	105,167.1
1975	79,050.6	10,192.2	68,858.4
1976	69,325.4	8,693.4	60,632.0
1977	84,763.2	8,876.9	75,886.3
1978	100,663.2	6,380.4	94,282.8
1979	102,305.4	7,057.5	95,247.9
1980	95,261.3	6,697.9	88,563.4
1981	101,960.8	7,954.0	94,006.8

[1]Source: Appendix 5, Section 1

[2]Source: Appendix 1, Section 3
Appendix 2, Section 3

3. Real net social value vs. industrial wood production



4. Statistical analysis of data

a. Real net social value

1.	$\bar{x}$ value ($)	72,951,957
2.	Range ($)	48,949,300 to 105,167,100
3.	Standard Deviation	19,238,459
4.	Coefficient of Variation (%)	26.37
5.	Average Annual Increase (%)	6.35

b. Nominal net social value

1.	Average Annual Increase (%)	14.64

c. Regression between industrial wood production and real net social value, where :

x = production
y = net social value

Equation of regression: [y = 21.4629 (x) + 22,238,234]

$r = 0.33$
$r^2 = 0.11$

Test of significance for r :

H_0 = The correlation coefficient r in the population is not significantly different from zero;

H_1 = The correlation coefficient r in the population is significantly different from zero.

Using a t-test, r in the population is not significantly different from zero to 0.20 level of significance. Reject H_1, Accept H_0.

5. Real and nominal value per m^3 and per ha.

Year	Value Per m^3 ($)		Value Per Ha. ($)	
	Nominal	Real	Nominal	Real
1968	21.73	24.30	2,259.51	2,526.97
1969	21.30	25.07	2,423.26	2,607.32
1970	21.35	21.99	2,220.03	2,287.34
1971	22.60	22.60	2,350.28	2,350.28
1972	24.58	23.46	2,556.83	2,439.93
1973	29.03	25.36	3,019.33	2,637.77
1974	45.25	34.30	4,706.46	3,567.28
1975	42.48	29.33	4,418.26	3,049.94
1976	42.80	27.09	4,450.81	2,817.60
1977	60.98	35.93	6,341.42	3,736.77
1978	78.78	43.29	8,192.89	4,502.09
1979	84.81	42.26	8,819.95	4,394.77
1980	78.26	35.06	8,139.23	3,646.39
1981	108.64	44.20	11,298.85	4,596.46

APPENDIX 7

Net Social Value Data For Finland

1. Forest industry GDP versus industrial wood consumption[1]

Year	Industry Wood Consumption[2] (000,000 m^3)	Implicit Price Index 1975 = 100	Shifted Index 1971 = 100	Nominal Forestry GDP[3] (000,000 Mk)	Real Forestry GDP[3] (000,000 Mk)
1967	39.0	32.2	70.8	2,972.7	4,198.7
1968	40.0	33.2	73.0	3,425.6	4,692.6
1969	44.0	36.4	80.0	4,587.9	5,734.9
1970	46.3	40.4	88.8	5,481.5	6,172.9
1971	44.0	45.5	100.0	5,387.7	5,387.7
1972	45.0	46.1	101.3	5,684.9	5,611.9
1973	46.5	59.4	130.5	7,738.0	5,929.5
1974	44.8	86.9	191.0	10,880.1	5,696.4
1975	33.1	100.0	219.8	9,553.5	4,346.5
1976	35.4	102.9	226.2	9,591.7	4,240.4
1977	38.1	106.6	234.3	10,988.0	4,689.7
1978	43.8	102.1	224.4	12,543.0	5,589.6
1979	53.6	104.3	229.2	16,678.0	7,276.6
1980	55.6	120.7	265.3	20,428.3	7,700.1
1981	50.5	141.9	311.9	21,004.6	6,734.4

[1] Source: Anon., 1983c. Yearbook of forest statistics 1982. Folia Forestalia 550, XVII A: 14. The Finnish Forest Research Institute, Helsinki.

[2] Includes roundwood and residues

[3] For harvesting, processing and forestry services

Regression between real GDP and wood consumption where :

x = industrial wood consumption
y = real GDP by forest industry

Equation of regression: [$y = 165.9971(x) - 1700.4283$]

$r = 0.9723$
$r^2 = 0.9454$

Test of significance :

Calculated t-value = 15.0029
t @ .001 level = 4.221 with 13 df.

H_0 : The correlation coefficient r in the population is not significantly different from zero.

H_1 : The correlation coefficient r in the population is significantly different from zero.

Reject H_0; Accept H_1

2. Calculation of real net social value for forestry[1].

Year	Nominal Forestry GDP (000,000 Mk)	Nominal Government Forestry Expenditure[2] (000,000 Mk)	Nominal Net Value[3] (000,000 Mk)	Real Net Value[4] (000,000 Mk)
1967	2,972.7	68.2	2,904.5	4,102.4
1968	3,425.6	81.8	3,343.8	4,580.5
1969	4,587.9	82.2	4,505.7	5,632.1
1970	5,481.5	79.6	5,401.9	6,083.2
1971	5,387.7	87.0	5,300.7	5,300.7
1972	5,684.9	98.4	5,586.5	5,514.8
1973	7,738.0	110.8	7,627.2	5,844.6
1974	10,880.1	127.7	10,752.4	5,629.5
1975	9,553.5	171.1	9,382.4	4,268.6
1976	9,591.7	205.4	9,386.3	4,149.6
1977	10,988.0	243.7	10,744.3	4,585.7
1978	12,543.0	253.5	12,289.5	5,476.6
1979	16,678.0	220.5	16,457.5	7,180.4
1980	20,428.3	220.5	20,207.8	7,617.0
1981	21,004.6	224.3	20,780.3	6,662.5

[1] Source: As in previous table

[2] Includes direct government expenditures and grants for reforestation, stand improvement, road construction and maintenance, and planning.

[3] Calculated as difference between nominal forestry GDP and government expenditures on forestry.

[4] Calculated by applying Implicit Price Index (from previous table), to nominal net value data.

Regression between real net social value and wood consumption where :

x = industrial wood consumption
y = real net social value

Equation of regression: [$y = 166.4413(x) - 1811.5407$]

$r = 0.9716$
$r^2 = 0.9439$

Test of significance:

Calculated t-value = 14.7903
t @ .001 level = 4.221 with 13 df.

H_o : The correlation coefficient r in the population is not significantly different from zero.

H_1 : The correlation coefficient r in the population is significantly different from zero.

Reject H_o; Accept H_1.